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FROM

The Board





ASHOKAN RESERVOIR—Olive Bridge Dam, August '18, 1908. General view looking South from head-towers.

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THIRD ANNUAL REPORT

OF THE

Board of Water Supply

OF THE

CITY OF NEW YORK



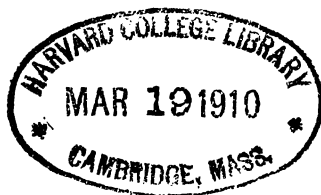
Accompanied by Report of

THE CHIEF ENGINEER

December 31, 1908

NEW YORK CITY

NY Doc 24, 20, 60



The Board.



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BOARD OF WATER SUPPLY CITY OF NEW YORK

299 BROADWAY.

NEW YORK, December 31, 1908.

HON. GEORGE B. McCLELLAN,
Mayor of The City of New York,
Executive Chamber,
City Hall, New York.

SIR:

We submit herewith the report of the Board of Water Supply of The City of New York for the year ending December 31, 1908.

During the year construction work begun in 1907 was augmented by the letting of additional contracts for about 15 miles of aqueduct, at an estimated cost of \$9,600,000, making a total of 25 miles to date at an estimated cost of \$13,800,000. Preparation of plans and specifications for new contracts and some preliminary investigations, especially into the geologic features along certain portions of the line of work, were continued, and on the whole the work is being vigorously and successfully prosecuted.

SUFFOLK COUNTY WATER

Among the many complex and interesting problems confronting the Board since its inception the study for the development of an additional supply of water from the ground-water sources of Suffolk county, to meet the imperative needs of the Borough of Brooklyn, is worthy of mention.

On March 18, the Commissioners addressed a letter to your Honor as Mayor and Chairman of the Board of Estimate and Apportionment, stating that "after an investigation extending over a period of nearly three years by the Consulting Engineers who are attached to the work of this Board, and also the direct investigations carried on by the engineering force of this Board, the Board is unanimously of the opinion that the situation of the water-supply for the Borough of Brooklyn is in such a state at the present time as to call for legislation enabling The City to

secure an additional supply of water in Suffolk county at the present time unavailable for use on account of legislative prohibition."

This general statement was supported by the following presentation of facts: During 1907 the Borough of Brooklyn received a water-supply to the extent of 145,000,000 gallons per day; within five years, with the Borough growing at its present rate, it will be necessary to increase this supply to 195,000,000 gallons daily. It is impossible to secure any additional supply for Brooklyn from the Catskill sources before eight or ten years from the present time, and in order to overcome a shortage of water in Brooklyn within the next few years, it is necessary to secure water from the more readily available Long Island sources.

On June 12, the Board of Estimate and Apportionment adopted a resolution fixing June 26, as the date for a hearing at the City Hall on the above recommendation. The Boards of Supervisors of the various counties interested were notified of the hearing, and additional publicity was secured through advertising in the *City Record*, and the papers of Brooklyn, Richmond county, Queens county, Nassau county and Suffolk county. On June 26, as the result of this hearing, the Board of Estimate and Apportionment adopted a resolution approving the report of the Board of Water Supply, adopting the maps, plans, and profile of the Board, and requesting the Board to apply as soon as possible to the State Water Supply Commission for approval of the said plans, maps, and profile, and directing the Corporation Counsel to "prepare such plans, and take such steps with that end in view as may be proper."

On July 27, a copy of a letter from the Chief Engineer, dated July 22, giving facts as to the character and purity of Suffolk County water, was forwarded to the State Water Supply Commission, and later a letter, dated July 31, was received from that Commission enclosing form of advertisement of hearing to be held at the Watson House, Babylon, Long Island, on September 10, 1908, to be published on various dates in New York and Brooklyn papers, Hempstead "Sentinel," Babylon "Southside Signal," Riverhead "County Review" and Patchogue "Advance."

At the above hearing all the members of the State Water Supply Commission were present. Mr. George L. Sterling, Assistant Corporation Counsel, represented The City of New York and the Corporation Counsel. There was a large attendance of interests opposed to the plan as well as of those who favored it.

Arguments were presented by Messrs. Stanchfield, Griffing, Baldwin, Junor, Wood, Olcott, DeWitt, and Assistant Corporation Counsel Sterling, who, under objection from Mr. Stanchfield and others, offered in evidence resolutions, ordinances, maps, etc., of a formal character, bearing on this application. The hearing was then adjourned to September 30, at the office of the Board of Water Supply, 299 Broadway, New York.

On September 30 the Commission again met in New York and listened to arguments by Messrs. Stanchfield and Auerbach, supporting, and by Assistant Corporation Counsel Sterling in opposition to, a motion for a rest of proceedings until a legal interpretation of the "Burr Act" could be had from the courts. The Commission thereupon decided to give three weeks for exchange of briefs and a week additional for reply, briefs to be filed with the Commission within four weeks. It was found, however, that the members of the State Water Supply Commission would not have sufficient time to consider the briefs which had been submitted, and further adjournments were made, taking the proceedings over into the year 1909.

ORGANIZATION

J. Edward Simmons, President of the Board of Water Supply, resigned on January 28 and on January 31 the certificate of appointment by the Mayor of John A. Bensel as a member of the Board of Water Supply was presented and on motion of Commissioner Chadwick, Mr. Bensel was elected President.

Organization of the Board's forces into Administration, Real Estate and Engineering bureaus remained unchanged except with the addition of a Police bureau. This bureau was placed under the direction of Commissioner Shaw, to whom all matters pertaining to the organization and administration have been delegated and to whom the Chief of Patrolmen reports. Rhinelander Waldo was appointed Chief of Patrolmen on Aqueduct on February 28. He resigned on October 9, and Douglas I. McKay was appointed to fill the vacancy.

The total force in the Administration bureau as on December 31 of this year and of last year, exclusive of the Commissioners and the Police force, is given in the following table:

BOARD OF WATER SUPPLY

ADMINISTRATION BUREAU FORCE

TITLE	1907	1908
Secretary.....	1	1
Auditor.....	1	1
Examiner of Real Estate and Damages.....	1	1
Examiner of Claims.....	..	1
Adjuster of Taxes and Assessments.....	..	1
Chief Clerk.....	1	1
Assistant Secretaries.....	1	2
Confidential Secretaries.....	2	3
Financial Clerk.....	1	1
Bookkeepers.....	2	1
Clerks.....	6	18
Junior Clerks.....	*5	..
Office Boys.....	*2	..
Stenographers and Typewriters.....	6	9
Typewriting Copyists.....	1	2
Messengers.....	2	2
Locomobile Engineman.....	..	1
Cleaner.....	1	1
Total.....	33	46

*Due to reclassification by the Municipal Civil Service Commission these are included in clerks.

ADMINISTRATION

Accounts. Submitted herewith is the Report and Financial Statement of the Auditor covering the financial operations of the Board of Water Supply for the year, and the total financial operations from June 9, 1905, to December 31, 1908.

This report is composed of Table 1, which is a summary of the operating and financial condition of the Board of Water Supply as at the close of business, December 31, 1908, together with six statements, supporting and amplifying the controlling figures set forth therein.

Beginning with Table 1, a careful perusal of this report will show that the general plan upon which it is based is sound, and sufficiently elastic to admit of any extension in the analysis of expenditures, or classification in the statements, as further progress or exigencies of the work may require, without departing from the general scheme of articulation with the controlling figures set forth in Table 1 of the report.

The statements in support of the controlling figures in Table 1 display the cost of conducting operations as follows:

- A. For administration purposes.
- B. For police purposes.
- C. For engineering purposes.

By consulting Statement 2, it will be noted that the total disbursements for engineering purposes during the period under review are established under three main classifications:

Surveys, maps, plans, etc.

Acquisition of property.

Permanent construction.

This statement presents in one complete picture the total disbursements for engineering purposes by divisions and departments, and also provides controlling figures for the succeeding statements, which display in further detail the activities of the Engineering bureau, separately under the main classifications established by

Geographical field departments,

Division of departments,

Types of structures or projects within the divisions.

The progress made since the inception of the work may be briefly noted in the following comparative table of disbursements for the years 1906, 1907 and 1908:

COMPARATIVE DISBURSEMENTS FOR 1906, 1907 AND 1908

	TOTAL FROM JUNE 9 1905, TO DEC. 31, 1906	1907	1908	TOTAL
Administration purposes	\$118,001.36	\$105,794.06	\$134,256.73	\$358,052.15
Police purposes.....	.....	.....	42,486.41	42,486.41
Engineering purposes:				
Surveys, maps, plans, etc.....	846,996.37	1,481,689.34	959,915.77	3,288,601.48
Acquisition of property.....	18,913.38	356,040.24	1,429,850.05	1,804,803.67
Permanent construction.....	.....	173,516.23	1,900,689.66	2,074,205.89
Total for all purposes...	\$983,911.11	\$2,117,039.87	\$4,467,198.62	\$7,568,149.60

The details of the foregoing disbursements will be found in the statements supporting the tables in the printed reports for 1906, 1907 and 1908.

The increase in the work of the Auditor's division of the Administration bureau may be noted in the following comparative table of bills and contract estimates acted upon, and vouchers prepared as compared with the year 1907.

During 1908, 4,232 vouchers amounting to \$4,467,198.62 were prepared in this office and forwarded to the Comptroller of The City of New York in payment of 5,646 bills, contract estimates and pay rolls received, showing an increase over 1907 as follows:

BOARD OF WATER SUPPLY

VOUCHERS TRANSMITTED TO THE COMPTROLLER

	1907	1908	INCREASE OVER 1907
Bills, contract estimates and pay rolls acted upon.	5,220	5,646	426
Vouchers forwarded to the Comptroller for payment..	3,217	4,232	1,015

The employees in the Auditor's division now number 11, an increase of 1 over that of the previous year, and the salaries for the year amounted to \$14,892.00, an increase of \$47.00 over last year.

Supplies. There were received in the Chief Clerk's office during the year 2,015 requisitions for supplies, numbered 5760 to 7774, inclusive, against which were issued 2,666 orders aggregating a total expenditure of \$138,010.17. The payrolls of the various monthly and weekly employees of the Board were disbursed in strict accordance with the instructions of The City Paymaster without the occurrence of any error. The records of these transactions have been kept on the books and files in the manner prescribed by the Board at the inauguration of this work.

Appropriations. A communication was received from the Board of Estimate and Apportionment transmitting a copy of a resolution adopted by that board on June 26, authorizing the Comptroller to issue Corporate Stock of The City of New York, to the amount of \$22,600,000 to be used in connection with the following contracts:

CONTRACTS FOR WHICH APPROPRIATIONS WERE MADE BY BOARD OF
ESTIMATE AND APPORTIONMENT

No. OF CONTRACT	DESCRIPTION
22	Bull Hill tunnel and adjacent cut-and-cover.
11	Esopus cut-and-cover.
9	Kensico dam and appurtenances.
15	Walkill south cut-and-cover.
20	Moodna siphon.
23	North end of Hunter's Brook tunnel to north end of Turkey Mountain siphon.
24	South end of Turkey Mountain siphon to middle of cut-and-over north of Croton tunnel.

On June 16, a communication was received from the Board of Estimate and Apportionment, transmitting copy of a resolution adopted by that Board authorizing the Comptroller to issue Cor-

porate Stock of The City of New York to the amount of \$11,000,000 for the construction of the deep pressure tunnels under the Rond-out creek and Wallkill river.

REAL ESTATE BUREAU

During the year considerable detail work was done by the Real Estate bureau under the personal direction and supervision of Commissioner Chadwick. Examinations were made of a great many parcels of real estate offered to The City at private sale, and in a number of these cases the property was purchased from the owners at prices always advantageous to The City. The heavy expense of condemnation was thus avoided and guiding prices were established in localities where condemnation proceedings were pending. The properties acquired by private agreement were as follows:

PROPERTIES ACQUIRED BY PRIVATE AGREEMENT Reservoir Department

PARCEL NO.	SECTION	COST
328	8	\$2,300
65	2	4,500
424	9	4,900
29 and 39	1	7,500
651 and 652	13	3,500

In the Northern Aqueduct department the maps filed show that The City would acquire in fee a strip of land approximately two miles in length through the Mohonk property which would be divided equally between cut-and-cover and tunnel construction. It was found, however, that a permanent easement would answer as well and negotiations were commenced with Mr. Smiley, the owner, which resulted in securing an easement in the land, and the fee of a building thereon, at a cost of \$28,500, thus saving The City many thousands of dollars.

AGREEMENT WITH THE WALLKILL VALLEY RAILROAD

A communication was received from the Board of Estimate and Apportionment, dated March 26, 1908, approving the agreement between the Wallkill Valley Railroad and The City of New York

under which The City will acquire a permanent easement through and across this property for the aqueduct and appurtenances.

The bureau has made a complete index of all the lands to be acquired by The City for the construction of Ashokan reservoir and the Catskill aqueduct. It has also made an index of the testimony taken before all commissioners of appraisal so that comparisons can be made at any time between the awards made by the commissioners of appraisal in any section and the prices asked by owners in the same locality who would offer to sell by private agreement. A large number of claims for damage to property resulting from the activities of surveying parties during preliminary investigations by The City were examined; where these claims were just they were recommended for payment, where exorbitant they have either been reduced or rejected.

ULSTER & DELAWARE RAILROAD

During the progress of the work it was found that it would be necessary to acquire in fee the right-of-way now used by the Ulster and Delaware Railroad Company between Stony Hollow and Boiceville, and to dedicate a strip of land to the Railroad Company to be used as a substitute route for the railroad between those points. Under Section 13 of Chapter 724 of the Laws of 1905, it appears that the Board of Estimate and Apportionment is vested with the power to adjust with the Railroad Company all claims of any nature whatsoever which the Company may make against The City, in consequence of the shifting of the railroad, or for any other reason. Subsequently, application was made to the Board of Estimate and Apportionment for an adjustment of this matter, and on April 7, a communication was received from that Board stating that a committee consisting of the Mayor, the Comptroller and the President of the Board of Water Supply, had been appointed to negotiate with the Ulster and Delaware Railroad Company for the removal or abandonment of that portion of the road which it is necessary to condemn in order to prosecute the work of the Board of Water Supply.

POLICE BUREAU

Pending action by the Municipal Civil Service Commission on the Board's recommendation made at the close of 1907, the many details incident to the permanent organization and equipment,

and the selection of a temporary force were worked out under the direction of Commissioner Shaw.

On notification by the Municipal Civil Service Commission that the exemptions of the positions of Chief of Patrolmen on Aqueduct and two Deputy Chiefs of Patrolmen on Aqueduct had been approved by the Mayor and by the State Civil Service Commission, Rhinelander Waldo was appointed Chief of Patrolmen on Aqueduct, at a salary of \$3,600 per annum and Douglas I. McKay Deputy Chief of Patrolmen on Aqueduct at a salary of \$3,000 per annum, their appointments to take effect from February 28.

At this time, although examinations for patrolmen had been held, no list from which to select candidates had been established by the Civil Service Commission, owing mainly to the large number of applicants and the consequent difficulty in rating examination papers. It, therefore, became necessary to employ a temporary force, pending the establishment of a permanent eligible list. Between March 11 and July 1, when the permanent list was received, temporary patrolmen were appointed and employed. One police station was established at Peekskill, one at Garrison and one at Brown's Station, and in their vicinity the temporary force was distributed along the line of work.

The first appointments from the permanent list were made July 9. Additions to and separations from the permanent force during the year were as follows:

POLICE FORCE DURING THE YEAR

GRADE	APPOINTED	**SEPARATED	EFFECTIVE DEC. 31
Chief of Patrolmen on Aqueduct.....	*2	1	1
Deputy Chief of Patrolmen on Aqueduct.....	*1	1	0
Patrolmen on Aqueduct.....	52	3	49

*Rhinelander Waldo resigned October 9, and Douglas I. McKay was appointed to fill the vacancy.

**Separations include four resignations and one dismissal.

A second eligible list of patrolmen was established December 11, 1908, but no appointments were made.

The force at present is divided into four squads with headquarters at Kingston. These squads are located along the aqueduct, as follows:

Squad No. 1.....Peekskill
 Squad No. 2.....Garrison
 Squad No. 3.....Brown's Station
 Squad No. 4.....High Falls.

The normal strength of a squad is thirteen men, consisting of a commanding officer and four reliefs of three men each. Patrol duty is performed both day and night. The tours of actual patrol are so arranged that an average of six hours per diem is spent on post, but this by no means represents all the time devoted to the performance of duty. Investigation of complaints, service of warrants and subpoenas, escort of prisoners to and from courts and prisons, care of personal and horse equipment and of horse—all are duties which increase materially the daily hours of service.

Compensation of patrolmen is at the rate of \$75.00 per month, out of which they must provide board and lodging and furnish and maintain their uniforms, the various articles of which are as follows:

ARTICLES FURNISHED BY PATROLMEN

Cap.....	for winter use, 16-ounce olive drab cloth
	for summer use, with detachable bell top of cotton Khaki
Blouse.....	16 or 22-ounce olive drab (optional)
Breeches.....	16 or 22-ounce olive drab (optional)
Puttee leggings.....	pigskin leather
Shoes.....	tan
Gauntlets.....	buckskin
Pommel slicker	
Overcoat.....	30-ounce olive drab

ARTICLES FURNISHED BY THE CITY

Revolver.....	Colt's 38-caliber
Night stick.....	locust wood
Belt.....	fair leather
Holster.....	fair leather
Club socket.....	fair leather
Twisters	
Whistle	
Rules and regulations	
Certificate case	

Houses acquired by The City in the course of condemning real estate have been utilized for quarters. This method has proved excellent in the past, but cannot always be followed in the future on account of the lack of suitable buildings in many localities.

ACTIVITIES DURING THE YEAR

The temporary force first assigned to duty encountered some difficulty in operating, a condition believed to have been due to uncertainty in the minds of local residents regarding the extent of authority vested in the force, to the lack of a uniform, and to the presence in the contractor's forces of a large foreign population, which re-

sponded slowly to an unfamiliar institution. In spite of many difficulties, however, much good was accomplished by the temporary force, notably during the summer, when an epidemic of typhoid fever broke out in the vicinity of Peekskill. Popular opinion blamed the unsanitary living conditions believed to exist among the foreign laborers. Through the activity of the police the source of contamination was traced to a point beyond the jurisdiction of the Board and it was demonstrated that the sanitary rules which were prepared by the Board for the regulation of the contractor's camp were being rigidly enforced. Numerous deaths occurred, and only the vigilance of the police is believed to have allayed a feeling among the local residents, which at the time seemed to be inimical to the work undertaken by The City.

With the establishment of the permanent force, however, operation became less difficult, because the powers and duties of the force were better understood and more clearly defined in the minds of those interested; local justices of the peace, before whom cases are brought in the first instance, were more familiar with the legal status of the force; and every assistance was accorded the legal machinery in determining questions of jurisdiction. Consequently, in localities where the force has operated for a period of some months, the residents feel that the protection to which they are legally entitled is being impartially and effectively supplied.

Among the laborers, the ignorant and naturally lawless foreign element, and particularly those of the worst criminal class who usually find a ready refuge in the camps of large construction operations, the moral effect of a uniformed police force has been salutary. Commonly, a large percentage of such labor carries arms and uses them without hesitation when occasion arises, frequently with fatal results. Every effort is being made to curtail this practice and thus prevent many crimes of violence.

The record of arrests for the year follows:

SUMMARY OF ARRESTS AND DISPOSITION THEREOF

Convictions.....	125	
Acquittals.....	30	
Suspended sentences.....	5	
Escaped.....	1	
Bail forfeited.....	2	
Pending (Grand Jury).....	1	
Total number of arrests.....	164	
Fines imposed.....		\$620.50
Imprisonment imposed (days).....		3,450

AGREEMENTS

During the year many agreements were made for various purposes in connection with the work of the Board. These agreements were made as a general rule with the lowest bidder, and the amount of money involved in individual agreements does not exceed \$25,000. The status of these agreements and those executed prior to January 1, 1908, but still in force on that date, will be found in full in the reports of the Auditor and the Chief Engineer on pages 46-48 and 126-131.

HUDSON RIVER CROSSING

The Ingersoll-Rand Company on November 5 submitted a proposition to rent a compressor power plant at or near Cornwall, with all appurtenances, for \$3,700 per month, the lease to continue not less than nine consecutive months, the agreement to give The City the privilege of purchasing the plant, including any leases, for the difference between the amount paid for rental charges and \$33,539, the price of the plant. This proposition was approved by the Board November 19.

Informal estimates for hoisting engines, boilers and equipment at the Hudson River shafts were received by the Board November 24, and the estimate of J. S. Mundy, the lowest received, in the sum of \$11,472, was accepted.

CONTRACTS

CONTRACT 1—TEST BORINGS AT HUDSON RIVER

On January 8, upon the recommendation of the Chief Engineer, the time for the completion of the work under Contract 1 with the American Diamond Rock Drill Company for borings was extended to January 1, 1909. On June 30, the estimated cost of this work was increased from \$170,000 to \$195,000, to cover cost of an additional hole.

On February 25, the request of the American Diamond Rock Drill Company for an assignment of Contract 1 to the Phoenix Construction Company was approved, subject to the consent of the surety company, and the approval of the Corporation Counsel. The approval of the legal department was obtained on March 18.

CONTRACT 3—MAIN DAMS FOR ASHOKAN RESERVOIR

On February 20, notice was served upon MacArthur Brothers Company, James O. Winston and Thomas S. Winston to begin work within ten days upon the construction of main dams for the Ashokan reservoir.

CONTRACT 5—KINGSTON INTERCEPTING SEWER

On February 20, notice was served upon the Haggerty Contracting Company to begin work within ten days under this contract for the construction of an intercepting sewer in the City of Kingston which had been awarded September 12, 1907.

CONTRACT "A"—PRINTING FIRST ANNUAL REPORT

On April 15, the Board received bids for the printing of the first annual report of the Board. These bids were referred to Commissioner Shaw and the Secretary for tabulation and report, and on April 28, the Board awarded this contract to the J. W. Pratt Company, their bid being the one which "in the judgment of this Board will best secure the efficient performance of the work."

CONTRACT 6—ESOPUS DIVISION OFFICE

On May 12, bids were received for the construction of a field office building for division and section engineers of the Board in the Town of Marbletown, and on May 27 the contract was awarded to John J. McLean, the lowest bidder. On December 29, the time for the completion of this contract was extended to January 28, 1909.

CONTRACT 14—WALLKILL PRESSURE TUNNEL

On May 12, bids were received for the construction of the Wallkill pressure tunnel, crossing under the valley of the Wallkill river, in the towns of New Paltz and Gardiner, Ulster county, and on May 27, the Board adopted a resolution setting forth that the bids "do not give the Board sufficient information to warrant making an award of this contract." The question of readvertisement was left to be settled later. Subsequently, this contract was subdivided into Contracts 36 and 37, and on July 21 the Board directed the Chief Engineer to submit new forms of contract for this work, bids to be requested on either contract or on the two parts of the work in one contract.

CONTRACT "B"—ENGINEERING SUPPLIES

On August 25 bids were received for furnishing supplies for the Engineering bureau. This contract was subdivided into four classes; namely, Class "A," Engineering Supplies; Class "B," Stationery; Class "C," Printed Forms and Class "D," Hardware. On September 8 this contract was awarded as follows: Class "A," Technical Supply Company in the sum of \$3,804.09; Class "B," The J. W. Pratt Company in the sum of \$1,789.18; Class "C," Continental Playing Card Company in the sum of \$1,876.05, and Class "D," Joseph N. Early in the sum of \$3,710.51.

CONTRACT 12—RONDOUT PRESSURE TUNNEL

On June 2, bids were received for the construction of the Rondout siphon, a deep pressure tunnel about 23,600 feet long, and two short stretches of plain concrete conduit, and after tabulation and report the Board awarded the contract to The T. A. Gillespie Company, the lowest bidder, in the sum of \$6,290,803.50, and on June 16 this contract was duly executed.

CONTRACT 11—PORTION OF CATSKILL AQUEDUCT IN ESOPUS
DIVISION

On July 23, the Board received bids for the construction of part of the Catskill aqueduct, consisting of about six and a half miles of plain concrete conduit, and about 3,470 feet of tunnel, known as Peak tunnel, situated west of the Hudson river, on the south side of Esopus Creek valley in the towns of Olive and Marbletown, Ulster county.

On July 28 the Board adopted a resolution awarding this contract to the Stewart-Kerbaugh-Shanley Co., in the sum of \$2,368,000.00.

CONTRACT 15—PORTION OF CUT-AND-COVER AQUEDUCT IN WALL-
KILL DIVISION

On September 1, the Board received bids for the construction of a three-mile stretch of plain concrete conduit, approximately between Ireland Corners and New Hurley in the towns of Gardiner, Plattekill and Shawangunk, Ulster county. On September 8 this contract was awarded to the Elmore & Hamilton Contracting Company in the sum of \$933,867.50.

CONTRACT 38—TEST BORINGS SOUTH OF HILL VIEW RESERVOIR

Bids for making borings along one or more lines south of Hill View reservoir, lying mainly in the Boroughs of the Bronx, Manhattan and Brooklyn, including lines crossing the Hudson river, probably between Seventh Avenue and Washington Bridge; and the East river, approximately between the Williamsburg and Brooklyn bridges, were received on November 17, and on November 25 this contract was awarded to the Snare & Triest Company, the lowest bidders, in the sum of \$105,678.00.

CONTRACT 2—PORTION OF CATSKILL AQUEDUCT IN PEEKSKILL DIVISION**SUSPENSION OF WORK**

The Chief Engineer, in a communication dated November 24, reported a practical suspension of work under Contract 2, with the Thomas McNally Company.

THE EIGHT HOUR LAW

Complaint having been made that provisions of the eight-hour law on public contract work had been violated by the contractor, Thomas McNally Company, an investigation was made by William W. Walling, State Factory Inspector, with the result that under date of May 15 he stated in his report that "The Thomas McNally Company was strictly complying with the provisions of Section 3 of the Labor Law as to hours of labor on public contract work." On May 23 Mr. Walling, in a communication to the Board of Water Supply, stated that "the State Department of Labor withdraws any complaint which has been filed against the Thomas McNally Company."

Subsequently, the Comptroller of The City of New York was notified of this action of the Department of Labor, as a result of which that official rescinded an order directing that no further payments be made under the contract.

TREATMENT OF SMALLPOX

On June 3, the Chief Engineer made a report to the Board with reference to a case of smallpox discovered at the Garrison tunnel shaft. The contractor's physician stated that the case was discovered on May 29. The building where the patient lived was quarantined, the health authorities notified, a pest house established and the patient, a negro, removed to it in charge of another negro. No one, except the physician, was allowed to see the pa-

tient, and two patrolmen were kept constantly on duty about the house. Meantime the working force was vaccinated, and the patient finally recovered without transmitting the disease to others.

TYPHOID FEVER OUTBREAK

A letter, dated February 10, was received from the State Board of Health, relating to the cause of an outbreak of typhoid fever in the McNally camp at Peekskill, and was referred to Commissioners Chadwick and Shaw for report. Instructions were at once given to the Chief Engineer to make an investigation and submit a report, and on February 18, the two Commissioners, with Dr. Joseph A. Shears, of the Board of Health of The City of New York, went to Peekskill for a personal investigation. They were accompanied by Department Engineer Ridgway and Division Engineer Sproul. A report by the latter, dated February 15, stated that persistent efforts had been made by representatives of the Board to enforce the terms of the contract relating to sanitation and pollution. The members of the Board, upon investigation, concluded that the sanitary conditions surrounding the camp are such as to preclude the probability of danger. The camp is at a safe distance from the stream with its drainage in another direction. The sewage is safely disposed of and every precaution has been taken by the Engineering bureau to enforce proper sanitation. A general examination of the watershed, outside of the jurisdiction of the Board of Water Supply, shows many possible sources of contamination, and on the whole the members of the Board and those who consulted with them agreed that "no evidence could be found of lack of intelligent precaution on the part of the engineers and contractor in the location of the camp and sanitary provisions."

The report of Dr. Shears stated that "the camp is in good sanitary condition," that its location is "such as to preclude the possibility of this brook being contaminated from this source," and that the brook was already contaminated by passing through a barnyard before reaching the McNally camp, all of its surface water being discharged into the brook.

The report of the Chief Engineer, based upon the investigations and reports of his associates, stated that it seemed "clear that the Peekskill authorities are not justified in assuming that the typhoid fever was caused by the McNally camp"; that "it is well known that many sources of pollution exist at many points in the Peekskill watershed outside of the jurisdiction of The City of New

York, and directly under the jurisdiction of the Peekskill authorities, and these in my opinion are more likely to be the cause of the existence of the typhoid fever than the operations of The City of New York."

On March 19, the Chief Engineer, in a report to the Board, stated that the joint Boards of Peekskill and the town of Cortlandt had visited the McNally camp, and had stated that it was in a sanitary condition, and that if it could be maintained in this condition it would not be necessary to move it.

The Peekskill Evening News, in its issue of April 10, stated that "the McNally camp had recently been inspected (by the State Inspector) and found in good condition."

The Peekskill Daily Union, on the same date, stated that "the inspector had investigated the McNally camp and found it in good condition."

CONTRACTS 36 AND 37—WALLKILL PRESSURE TUNNEL

Bids were received by the Board for Contract 36, for the construction of the north half of the Wallkill pressure tunnel, a tunnel in rock crossing under the valley of the Wallkill river, with three shafts 350 to 480 feet in depth, and a short stretch of concrete conduit; and for Contract 37 for the construction of the south half of the Wallkill pressure tunnel, with three shafts 350 to 400 feet in depth, and a short stretch of plain concrete conduit, in the towns of New Paltz and Gardiner, Ulster county.

On December 17 all bids were rejected, and the Secretary was directed to re-advertise these contracts.

OPINIONS OF CORPORATION COUNSEL

During the year, as necessity arose, the advice of the Corporation Counsel, the legal adviser of the Board, was constantly sought on legal matters involving the powers and duties of the Board.

A list of the subjects upon which opinions were received, with the date of each, is given in Appendix I.

The report of the Chief Engineer follows:

Respectfully submitted,

JOHN A. BENSEL,
CHARLES N. CHADWICK,
CHARLES A. SHAW,

Commissioners,

Board of Water Supply.

REPORT AND FINANCIAL STATEMENT OF THE BOARD OF WATER SUPPLY OF THE CITY OF NEW YORK

SHOWING DISBURSEMENTS FOR THE YEAR 1908 AND FOR THE PERIOD BEGINNING JUNE 9, 1905, AND ENDING DECEMBER 31, 1908, CLASSIFIED BY DEPARTMENTS, DIVISIONS OF WORK, ETC.

TABLE 1 Summary of Financial Condition of the Board of Water Supply at Close of Business December 31, 1908, as supported by the following Statements:—

STATEMENT 1	Classified Disbursements, Administration Bureau.
STATEMENT 1-A	Classified Disbursements, Police Bureau by Detachments.
STATEMENT 2	Classified Disbursements, Engineering Bureau by Departments and Divisions.
STATEMENT 3	Classified Disbursements, Engineering Bureau, Account Surveys, Maps, Plans, etc., by Departments and Divisions.
STATEMENT 3-A	Classified Disbursements, Engineering Bureau, Northern Aqueduct Department by Divisions and Sub-divisions of Work.
STATEMENT 3-B	Classified Disbursements, Engineering Bureau, Southern Aqueduct Department by Divisions and Sub-divisions of Work.
STATEMENT 4	Classified Disbursements, Engineering Bureau, Account Acquisition of Property by Departments and Divisions.
STATEMENT 5	Classified Disbursements, Engineering Bureau, Account Permanent Construction by Field Departments and Divisions.
STATEMENT 6	Estimated Liabilities on Account of Contracts and Special Agreements as of December 31, 1908.
STATEMENT 6-A	Completed Contracts and Agreements.

Respectfully submitted,

H. C. BUNCKE, Auditor.

TABLE 1

SUMMARY OF THE FINANCIAL CONDITION OF THE BOARD OF WATER SUPPLY AT THE CLOSE OF BUSINESS
DECEMBER 31, 1908

Amount of Corporate Stock Authorised to be Issued, Pursuant to Chapter 724, Laws of 1905 and in accordance with Resolutions adopted by the Board of Estimate and Apportionment, between June 16, 1905, and June 26, 1908.....	\$60,202,000.00	
Premium on sale of \$5,862,500.00 Water Bonds.....	145,568.62	
Miscellaneous revenue.....	1,953.26	\$60,349,521.88
AMOUNT OF VOUCHERS REGISTERED AND CERTIFIED TO THE COMPTROLLER FOR PAYMENT DURING THE YEAR 1908, AND FROM JUNE 9, 1905, TO DECEMBER 31, 1908		
	Year 1908	Total from Jun. 9, 1905, to Dec. 31, 1908
Per Statement 1, Disbursements, Administration bureau...	\$134,256.73	\$358,052.15
Per Statement 1-A, " Police bureau.....	42,486.41	
Per Statement 2, " Engineering bureau.....	4,290,455.48	7,167,611.04
	\$4,467,198.62	7,568,149.60
Registered contract liabilities as of December 31, 1908, per Statement 6.....		24,825,407.21
Estimated liabilities under special agreements as of December 31, 1908, per Statement 6....		391,421.12
Liabilities for acquisition of property by condemnation proceedings as of December 31, 1908, and other expenses incidental thereto.....		499,550.16
All other liabilities on open orders, etc., as of December 31, 1908:		
Amount unliquidated November 30, 1908.....	\$47,515.83	
New liabilities contracted during December, 1908.....	101,513.36	
	\$149,029.19	
Liquidated during December, 1908.....	99,989.59	
	\$49,039.60	33,333,567.69
AMOUNT AVAILABLE, i. e., Excess of bond authorisation over disbursements and liabilities.....		\$37,015,954.19

STATEMENT 1

CLASSIFICATION OF DISBURSEMENTS, ADMINISTRATION BUREAU, DURING THE YEAR 1908, AND FROM JUNE 9, 1905 TO DECEMBER 31, 1908

	1908	Total from Jun. 9, 1905, to Dec. 31, 1908
Salaries of Commissioners.....	\$35,935.48	\$128,135.47
All other salaries.....	63,505.60	140,598.62
Furniture and fixtures.....	4,164.33	11,817.66
Traveling expenses.....	5,101.27	10,222.06
Stationery and printing.....	6,786.82	13,553.60
Postage, telegrams, telephone and messenger service.....	1,343.19	3,077.35
Rent of main offices.....	10,440.54	22,199.56
Advertising.....	**984.65	1,806.65
Contingent fund.....	...	5,000.00
Miscellaneous expenses.....	3,892.51	8,868.15
Transportation equipment.....	4,275.00	4,275.00
Advertising proposals.....	**595.25	126.00 |
	133,864.84	349,680.12
COST OF STATE BOARD HEARINGS		
Stenographic services.....	...	4,990.31
Advertising.....	258.16	3,197.99
All other expenses.....	133.73	183.73
	\$134,256.73	\$358,063.15

* Credit caused by transfer to Northern Aqueduct Department, Peekskill Division, Permanent Construction

** Credit caused by transfer to Northern Aqueduct Department, Hudson River Siphon

STATE

**CLASSIFICATION OF DISBURSEMENTS BY DETACHMENTS AND TOTAL DISBURSEMENTS
AND FROM JUNE 9, 1905**

	HEADQUARTERS DETACHMENT		PEEKSKILL DETACHMENT	
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
Salaries.....	\$5,760.51	\$5,760.51	\$9,645.67	\$9,645.67
PERMANENT EQUIPMENT				
Horses.....	650.00	650.00		
Furniture and fixtures.....	295.70	295.70	49.80	49.80
Other equipment.....	1,858.25	1,858.25	17.05	17.05
Harness.....	80.70	80.70	22.85	22.85
Offices and buildings.....				
CONSUMABLE SUPPLIES				
Forage.....	45.61	45.61		
Horse-shoeing.....	13.90	13.90	2.00	2.00
Other stable expenses.....	5.50	5.50	1.50	1.50
Postage, telegrams, telephone and messenger service.....	.92	.92	3.00	3.00
Traveling expenses.....	209.20	209.20	59.71	59.71
Stationery and printing.....	47.50	47.50	.10	.10
Miscellaneous expenses.....	14.15	14.15	5.05	5.05
Ammunition.....	10.34	10.34		
Fuel and light.....				
Boarding horses.....	30.75	30.75		
Total.....	\$9,023.03	\$9,023.03	\$9,806.73	\$9,806.73

MENT 1-A

PURSEMENTS CLASSIFIED OF POLICE BUREAU DURING THE YEAR 1908,
TO DECEMBER 31, 1908

GARRISON DETACHMENT		BROWN'S STATION DETACHMENT		HIGH FALLS DETACHMENT		BUREAU TOTALS	
1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
9,369.32	\$9,369.32	\$8,642.27	\$8,642.27	\$2,355.16	\$2,355.16	\$35,772.93	\$35,772.93
46.96	46.96	56.82	56.82	7.69	7.69	650.00	650.00
		6.56	6.56	15.60	15.60	456.97	456.97
						1,897.46	1,897.46
						103.55	103.55
		2,711.00	2,711.00			2,711.00	2,711.00
23.39	23.39					69.00	69.00
1.30	1.30	1.22	1.22			15.90	15.90
.80	.80	1.15	1.15			9.52	9.52
93.51	93.51	221.57	221.57	6.29	6.29	5.87	5.87
23.36	23.36	64.52	64.52	1.13	1.13	590.28	590.28
		7.03	7.03			47.60	47.60
						108.21	108.21
						10.34	10.34
						7.03	7.03
						30.75	30.75
9,558.64	\$9,558.64	\$11,712.14	\$11,712.14	\$2,385.87	\$2,385.87	\$42,486.41	\$42,486.41

STATEMENT 2 (Concluded)
**CLASSIFICATION OF DISBURSEMENTS BY DEPARTMENTS AND DIVISIONS AND TOTAL DISBURSEMENTS CLASSIFIED OF
 ENGINEERING BUREAU, DURING THE YEAR 1908, AND FROM JUNE 9, 1905 TO DECEMBER 31, 1908**

FOR DETAILED EXPENDITURES, SEE	STATEMENT 3		STATEMENT 4		STATEMENT 5		DIVISION AND DEPARTMENT TOTALS
	SURVEYS, MAPS, PLANS, ETC.		ACQUISITION OF PROPERTY		PERMANENT CONSTRUCTION		
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	
SOUTHERN AQUEDUCT DEPARTMENT							
Executive Division.....	\$30,951.15	\$68,363.36	.....	.....	.....	\$30,951.15	\$68,363.36
Croton Division.....	51,041.11	108,644.93	.....	.....	.....	51,041.11	108,644.93
Kensico Division.....	47,012.19	135,101.55	\$176,819.48	\$216,408.23	.....	223,831.67	371,909.88
Water Plans Division.....	17,861.46	39,401.56	.....	.....	.....	17,861.46	39,401.56
Hill View Division.....	19,665.14	28,441.18	299,261.81	315,349.49	.....	318,926.95	343,790.67
Total.....	166,531.05	\$377,932.63	476,081.29	531,757.72	.....	643,612.34	\$909,710.40
LONG ISLAND DEPARTMENT							
Executive Division.....	26,723.92	52,311.22	.....	.....	.....	26,723.92	52,311.22
Topographic Surveys.....	47,676.54	109,747.65	.....	.....	.....	47,676.54	109,747.65
Test-Borings.....	20,554.13	83,875.63	.....	.....	.....	20,554.13	83,875.63
Stream Gaging.....	4,605.71	9,525.21	.....	.....	.....	4,605.71	9,525.21
Total.....	99,560.30	\$255,359.71	.....	.....	.....	99,560.30	\$255,359.71
RONDOUT SUPPLY							
.....	13,236.28	31,211.65	.....	.....	.....	13,236.28	31,211.65
SCHOHARIE SUPPLY							
.....	7,251.55	17,505.62	.....	.....	.....	7,251.55	17,505.62
*CATSKILL SUPPLY							
.....	2,916.83	3,223.76	.....	.....	.....	2,916.83	3,223.76
PRELIMINARY EXPENSES FROM JUNE 9, 1905, TO JULY 31, 1906.....							
.....	.....	406,024.71	.....	.....	.....	.....	406,024.71
ENGINEERING BUREAU, Totals.....							
.....	\$956,915.77	\$3,238,601.48	\$1,439,850.05	\$1,804,803.67	\$1,900,689.66	\$3,074,205.89	\$4,290,455.48
.....	.....	.....	.....	.....	.....	.....	\$7,167,611.04

*Catskill creek watershed

STATE

CLASSIFICATION OF DISBURSEMENTS BY DEPARTMENTS AND DIVISIONS AND TOTAL DISBURSEMENTS, ETC., DURING THE YEAR 1908, AND FISCAL YEAR 1909

	SALARIES		PERMANENT EQUIPMENT		CONSUMABLES
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908
HEADQUARTERS DEPARTMENT					
Executive Division.....	\$111,639.12	\$264,830.20	*\$21,862.37	\$34,975.38	\$38,115.37
Designing Division.....	153,675.16	302,726.79	826.94	13,518.52	13,119.11
Laboratory and Inspection Division.....	25,989.52	54,943.48	1,345.95	10,314.27	8,773.11
Pipe Line and Distribution Division.....	8,856.74	9,668.24	1,031.65	1,032.20	1,581.61
Total.....	300,160.54	632,168.71	*18,657.83	59,840.37	61,589.19
RESERVOIR DEPARTMENT					
Executive Division.....	31,296.61	53,006.35	2,666.77	6,533.13	8,420.11
Relocation of Railroads, Highways and Bridges.....	13,578.50	53,517.92		11.23	944.61
Stripping.....	50.00	1,550.00		3.28	
Topographic Surveys.....	1,050.00	20,403.97		318.46	263.61
Main Dams.....	2,202.88	117,325.58	469.03	16,147.76	1,899.31
Hurley Dikes.....	1,401.75	2,246.43	66.55	149.63	355.61
Total.....	49,579.74	248,050.25	3,202.35	23,163.49	11,883.31
NORTHERN AQUEDUCT DEPARTMENT					
Executive Division.....	27,363.66	63,494.52	736.36	11,587.74	7,949.01
Esopus Division.....	19,828.65	82,557.40	2,250.73	7,025.01	7,686.91
Wallkill Division.....	18,569.96	51,839.33	1,123.53	2,263.56	4,695.61
Newburg Division.....	23,949.32	33,090.50	1,617.30	2,204.84	5,508.21
Hudson River Division.....	42,259.06	85,662.31	1,614.87	3,641.48	7,360.31
Peekskill Division.....	7,169.00	58,323.15	381.55	8,504.21	1,911.11
Total.....	139,139.65	374,967.21	7,724.34	35,226.84	35,111.91
SOUTHERN AQUEDUCT DEPARTMENT					
Executive Division.....	19,351.89	42,855.89	4,464.13	9,320.44	7,135.11
Croton Division.....	30,434.15	52,216.07	257.08	745.63	4,732.71
Kensico Division.....	26,682.79	72,168.86	461.37	1,450.54	4,693.01
White Plains Division.....	13,721.26	31,277.89	231.35	306.25	1,197.51
Hill View Division.....	7,577.94	14,365.53		3.23	584.51
Total.....	97,768.03	212,884.24	5,413.93	11,826.09	18,342.91
LONG ISLAND DEPARTMENT					
Executive Division.....	18,102.59	31,331.92	939.19	7,554.77	7,682.11
Topographic Surveys.....	40,843.33	92,528.08	154.29	866.36	6,618.91
Test-Borings.....	7,922.60	23,261.46	4,406.07	21,991.02	8,225.41
Stream Gaging.....	2,676.37	5,391.32	30.50	391.59	1,898.81
Total.....	69,544.89	152,512.78	5,530.05	30,803.74	24,425.21
RONDOUT SUPPLY.....	5,203.75	18,175.72	209.75	355.61	1,746.11
SCHOHARIE SUPPLY.....	4,343.33	12,659.62	834.55	884.82	2,073.11
**CATSKILL SUPPLY.....	2,094.00	2,427.12	148.07	163.07	674.11
PRELIMINARY EXPENSES FROM JUNE 9, 1905 TO JULY 31, 1906.....		222,538.18		46,705.85	
ENGINEERING BUREAU, Totals.....	\$667,833.93	\$1,876,383.83	\$4,405.21	\$208,969.88	\$155,847.11

*Credits caused by adjustment of Storeroom

**Catskill creek watershed

[ENT 3

EXPENSES CLASSIFIED BY ENGINEERING BUREAU, ACCOUNT SURVEYS, MAPS, PLANS,
FROM JUNE 9, 1905 TO DECEMBER 31, 1908

SUPPLIES	CONTRACTS		AGREEMENTS		DAMAGES		DIVISION AND DEPARTMENT TOTALS	
Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
\$82,926.95							\$127,892.12	\$382,732.53
18,096.71							167,621.29	334,342.02
20,521.72			\$2,002.00	\$7,106.33			38,110.66	92,885.80
1,783.11							11,470.04	12,483.55
123,328.49			2,002.00	7,106.33			345,094.11	822,443.90
14,812.38							42,383.48	74,351.86
7,008.03							14,523.10	60,537.18
445.77							50.00	1,999.05
4,163.23						\$50.00	1,313.84	24,935.66
38,319.64				76,197.69		1,462.00	4,571.24	249,452.67
982.68							1,823.95	3,378.74
65,731.73				76,197.69		1,512.00	64,665.41	414,655.16
19,603.88							36,049.10	94,686.14
20,919.09			13,684.60	78,550.94	\$25.00	90.00	43,475.94	189,142.44
10,587.86				27,646.65	1,231.50	2,100.00	25,620.68	94,437.40
7,376.00			5,040.82	8,863.55	130.00	130.00	36,245.65	51,664.89
14,814.64	\$15,727.59	\$88,241.30	39,765.84	200,112.83	3,080.00	4,080.00	109,808.16	396,552.56
13,952.28				53,961.22			9,461.71	134,740.86
87,253.75	15,727.59	88,241.30	58,491.26	369,135.19	4,466.50	6,400.00	260,661.24	961,224.29
16,187.03							30,951.15	68,363.36
8,859.56			15,588.89	44,795.38	28.29	28.29	51,041.11	106,644.93
9,285.92			15,150.00	52,171.33	25.00	25.00	47,012.19	135,101.65
2,050.61			2,711.31	5,766.81			17,861.46	39,401.56
1,142.88			11,502.70	12,929.54			19,665.14	28,441.18
37,526.00			44,952.90	115,663.06	53.29	53.29	166,531.05	377,952.68
13,424.53							26,723.92	52,311.22
16,268.21					60.00	85.00	47,676.54	109,747.65
20,006.28				18,416.87			20,554.13	83,675.63
2,989.90				752.40			4,805.71	9,525.21
52,688.92				19,169.27	60.00	85.00	99,560.30	255,259.71
4,675.92			6,075.60	8,004.40			13,235.28	31,211.65
3,961.18							7,251.55	17,505.62
733.57							2,916.83	3,323.76
135,288.30						492.38		405,024.71
\$11,187.86	\$15,727.59	\$88,241.30	\$111,521.76	\$595,275.94	\$4,679.79	\$8,542.67	\$959,915.77	\$3,288,601.48

STATEMENT

**CLASSIFICATION OF DISBURSEMENTS BY DIVISIONS AND SUB-DIVISIONS OF WORK AND
SURVEYS, MAPS, PLANS, ETC., DURING THE YEAR 1908**

	SALARIES		PERMANENT EQUIPMENT		CONSUMABLES
	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908
EXECUTIVE DIVISION.....	\$27,363.66	\$63,494.52	\$736.36	\$11,587.74	\$7,940.00
ESOPUS DIVISION					
Executive.....	2,803.69	10,632.05	475.90	3,147.22	1,137.00
Pressure Tunnel.....	7,855.95	30,670.88	1,096.64	3,107.88	3,880.00
Cut-and-Cover.....	8,913.99	39,432.80	596.47	684.39	2,490.00
Grade Tunnel.....	82.27	1,598.92	66.28	70.08	151.00
Steel Pipe Siphons.....	172.75	172.75	15.44	15.44	42.00
Total.....	19,828.65	82,557.40	2,250.73	7,025.01	7,600.00
WALLKILL DIVISION					
Executive.....	4,758.36	25,733.29	142.18	1,253.99	770.00
Pressure Tunnel.....	2,183.10	6,006.31	398.84	402.95	1,110.00
Cut-and-Cover.....	11,388.50	19,446.32	439.74	463.85	2,600.00
Grade Tunnel.....	240.00	653.41	142.77	142.77	200.00
Total.....	18,569.96	51,839.33	1,123.53	2,263.56	4,680.00
NEWBURG DIVISION					
Executive.....	5,640.46	13,878.42	1,240.25	1,827.79	1,320.00
Cut-and-Cover.....	17,456.99	18,360.21	359.13	359.13	4,030.00
Steel Pipe Siphons.....	851.87	851.87	17.92	17.92	140.00
Total.....	23,949.32	33,090.50	1,617.30	2,204.84	5,590.00
HUDSON RIVER DIVISION					
Executive.....	2,389.38	10,266.67	779.09	1,816.01	1,640.00
East Test Shaft.....	4,138.02	4,138.02			90.00
West Test Shaft.....	8,550.98	8,550.98			90.00
Pressure Tunnel.....	19,556.09	35,310.96	708.07	1,168.86	4,430.00
Cut-and-Cover.....	4,745.43	13,726.04	71.95	72.76	620.00
Grade Tunnel.....	2,227.50	7,381.73	32.39	32.39	190.00
Steel Pipe Siphons.....	651.66	6,287.91	23.37	551.46	20.00
Total.....	42,259.06	85,662.31	1,614.87	3,641.48	7,360.00
PEEKSKILL DIVISION					
Executive.....	107.25	4,856.52		7,157.23	0.00
Cut-and-Cover.....	2,761.17	32,292.67	156.51	318.09	92.00
Grade Tunnel.....	1,029.95	5,618.54	*110.55	122.85	30.00
Steel Pipe Siphons.....	3,270.63	15,555.42	335.59	905.94	54.00
Total.....	7,169.00	58,323.15	381.55	8,504.21	1,91.00
Department Totals.....	\$139,139.65	\$374,967.21	\$7,724.34	\$35,226.84	\$35,110.00

*Credit caused by transfer to salaries

NT 3-A

**TOTAL DISBURSEMENTS CLASSIFIED OF NORTHERN AQUEDUCT DEPARTMENT, ACCOUNT
AND FROM AUGUST 1, 1906 TO DECEMBER 31, 1908**

SUPPLIES	CONTRACTS		AGREEMENTS		DAMAGES		STRUCTURE AND DIVISION TOTALS	
	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906
\$19,603.88							\$36,049.10	\$94,686.14
5,094.25					\$25.00	\$80.00	4,442.46	18,953.52
9,430.65			\$13,684.60	\$78,550.94		10.00	26,497.27	121,770.35
5,954.46							12,005.74	46,121.65
397.08							1,299.63	2,066.08
42.65							230.84	230.84
20,919.09			13,684.60	178,550.94	25.00	90.00	43,475.94	189,142.44
3,416.58					1,231.50	2,100.00	6,911.81	32,503.86
2,472.43				24,260.49			3,693.66	33,142.18
4,455.85				3,386.16			14,432.44	27,752.18
243.00							582.77	1,039.18
10,587.86				27,646.65	1,231.50	2,100.00	25,620.68	94,437.40
3,057.39			559.37	596.87	130.00	130.00	8,890.68	19,490.47
4,189.87			4,432.45	7,852.05			26,287.44	30,741.26
148.74			49.00	414.63			1,067.53	1,433.16
7,376.00			5,040.82	8,863.55	130.00	130.00	36,245.65	51,664.89
5,388.46		\$8,596.13		6,718.20	3,080.00	3,080.00	7,896.49	35,865.47
93.75							4,231.77	4,231.77
93.75							8,644.73	8,644.73
6,075.32	\$15,727.59	79,645.17	39,765.84	174,746.04		1,000.00	80,163.26	297,946.35
1,347.67							5,445.37	15,146.47
288.57							2,457.40	7,702.69
1,527.12				18,648.59			969.14	27,015.08
14,814.64	15,727.59	88,241.30	39,765.84	200,112.83	3,080.00	4,080.00	109,808.16	396,552.56
5,118.75							169.45	17,132.50
4,206.43				3,336.56			3,841.28	40,153.75
889.18				2,779.70			1,299.73	9,410.37
3,737.92				47,844.96			4,151.25	68,044.24
13,952.28				53,961.22			9,461.71	134,740.86
\$87,253.75	\$15,727.59	\$88,241.30	\$58,491.26	\$369,135.19	\$4,466.50	\$8,400.00	\$260,661.24	\$961,224.29

STATEMENT

CLASSIFICATION OF DISBURSEMENTS BY DIVISIONS AND SUB-DIVISIONS OF WORK AND
ACCOUNT SURVEYS, MAPS, PLANS, ETC., DURING THE YEAR

	SALARIES		PERMANENT EQUIPMENT		CONSUMABLES
	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908
EXECUTIVE DIVISION	\$19,351.89	\$42,855.89	\$4,464.13	\$9,320.44	\$7,135.12
CROTON DIVISION					
Executive.....	438.50	11,724.37	214.87	625.40	561.08
Pressure Tunnel.....	2,519.53	3,924.03	3.10	18.10	398.17
Cut-and-Cover.....	18,766.28	25,044.28	33.96	92.58	2,273.16
Grade Tunnel.....	7,127.63	9,243.18	5.05	8.35	1,248.34
Steel Pipe Siphons.....	1,582.21	2,280.21	.10	1.20	251.95
Total.....	30,434.15	52,216.07	257.08	745.63	4,732.70
KENSICO DIVISION					
Executive.....	3,018.45	14,130.43	211.58	1,125.30	3,086.65
Stripping.....	150.00	1,079.10		4.37	
Topographic Surveys.....	4,895.39	18,222.85	2.10	6.78	342.63
Highways.....	3,813.97	9,844.23		8.61	415.49
Dam and Dike.....	9,340.45	21,901.02	238.05	285.36	483.46
Cut-and-Cover.....	4,772.29	6,298.99	9.64	20.12	355.55
Tunnels.....	692.24	692.24			9.25
Total.....	26,682.79	72,168.86	461.37	1,450.54	4,693.03
WHITE PLAINS DIVISION					
Executive.....	850.00	11,813.34		9.65	348.42
Filters.....	4,603.85	6,790.10	.25	.25	196.87
Cut-and-Cover.....	6,970.90	11,027.44	231.10	296.35	590.11
Tunnels.....	846.15	846.15			35.95
Steel Pipe Siphons.....	450.36	800.86			26.19
Total.....	13,721.26	31,277.89	231.35	306.25	1,197.54
HILL VIEW DIVISION					
Executive.....	300.00	4,485.69		2.68	47.20
Reservoir.....	3,405.99	3,892.39			233.49
Cut-and-Cover.....	2,241.55	3,842.05		.55	72.83
Steel Pipe Siphons.....	1,630.40	2,145.40			230.98
Total.....	7,577.94	14,365.53		3.23	584.50
Department Totals.....	\$97,768.03	\$212,884.24	\$5,413.93	\$11,826.09	\$18,342.90

T 3-B

**TOTAL DISBURSEMENTS CLASSIFIED OF SOUTHERN AQUEDUCT DEPARTMENT,
08 AND FROM AUGUST 1, 1906 TO DECEMBER 31, 1908**

SUPPLIES Total from Aug. 1, 1906	CONTRACTS		AGREEMENTS		DAMAGES		STRUCTURE AND DIVISION TOTALS	
	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906	1908	Total from Aug. 1, 1906
14,187.08							\$30,951.15	\$68,363.36
3,227.45					\$28.29	\$28.29	1,242.74	15,605.51
610.86			\$7,512.75	\$12,645.65			10,433.55	17,198.64
2,951.68			2,653.04	3,023.13			23,726.44	31,111.67
1,577.18			4,482.20	6,365.40			12,863.22	17,194.11
492.39			940.90	22,761.20			2,775.16	25,535.00
\$859.56			15,588.89	44,795.38	28.29	28.29	51,041.11	106,644.93
\$192.42					25.00	25.00	6,341.68	20,473.15
36.25							150.00	1,119.72
1,721.70							5,240.12	19,951.33
595.31			440.81	440.81			4,670.27	10,888.96
1,045.80			10,682.51	47,703.84			20,744.47	70,936.02
685.19			504.00	504.00			5,641.48	7,508.30
9.25			3,522.68	3,522.68			4,224.17	4,224.17
\$285.92			15,150.00	52,171.33	25.00	25.00	47,012.19	135,101.65
660.22				1,485.00			1,198.42	13,968.21
395.77			634.50	2,205.00			5,435.47	9,391.12
931.58							7,792.11	12,255.37
35.95			1,707.81	1,707.81			2,589.91	2,589.91
27.09			369.00	369.00			845.55	1,196.95
\$2,050.61			2,711.31	5,766.81			17,861.46	39,401.56
417.64				328.84			347.20	5,234.85
259.99			2,215.30	3,043.30			5,854.78	7,195.68
209.64			542.40	542.40			2,856.78	4,594.64
255.61			8,745.00	9,015.00			10,606.38	11,416.01
1,142.88			11,502.70	12,929.54			19,665.14	28,441.18
1,526.00			\$44,952.90	\$115,663.06	\$53.29	\$53.29	\$166,531.05	\$377,952.68

STATEMENT

CLASSIFICATION OF DISBURSEMENTS BY DEPARTMENTS AND TOTAL DISBURSEMENTS CLASSIFIED BY DEPARTMENTS

YEAR 1908, AND FROM JUNE 9, 1905

	ENGINEERING SALARIES AND OTHER EXPENSES		EXPENSES INCURRED IN CONNECTION WITH THE CONSTRUCTION OF THE HILL VIEW DIVISION				
			ADVERTISING		EXPENSES OF SPECIAL COUNSEL AND COMMISSIONERS OF APPRAISAL		1908
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	
HEADQUARTERS DEPARTMENT	\$19,337.55	\$37,124.84					
RESERVOIR DEPARTMENT	31,979.98	74,325.83	\$10,029.00	\$60,378.79	\$217,451.97	\$307,641.49	\$237,211.11
NORTHERN AQUEDUCT DEPARTMENT							
Esopus Division.....	3,228.59	3,228.59	19,757.60	22,564.60	29,167.05	29,167.05	21,300.00
Wallkill Division.....	3,233.80	3,233.80	15,815.44	16,785.64	20,819.59	20,819.59	5,610.00
Newburg Division.....	5,502.55	5,502.55	5,590.15	5,590.15	7,347.49	7,347.49	
Hudson River Division.....	5,472.91	5,472.91	171.56	171.56			
Peekskill Division.....	1,249.58	1,499.58	563.96	26,356.33	51,024.37	85,016.59	137,110.00
Total.....	18,687.43	18,937.43	41,898.71	71,468.28	108,358.50	142,350.72	164,000.00
SOUTHERN AQUEDUCT DEPARTMENT							
Kensico Division.....	12,365.82	30,480.25	33,341.80	54,147.40	76,948.31	77,617.03	45,700.00
Hill View Division.....	9,179.52	9,596.18	1,412.24	6,862.38	74,889.87	85,110.75	183,200.00
Total.....	21,545.34	40,076.43	34,754.04	61,009.78	151,838.18	162,727.78	228,900.00
ENGINEERING BUREAU Totals	\$91,550.30	\$170,464.53	\$86,681.75	\$192,856.85	\$477,648.65	\$612,719.99	\$630,200.00

ENT 4

IFIED OF ENGINEERING BUREAU, ACCOUNT ACQUISITION OF PROPERTY DURING THE
905 TO DECEMBER 31, 1908

EMNATION PROCEEDINGS							DIVISION AND DEPARTMENT TOTALS		
WARDS	INTEREST ON AWARDS		COUNSEL FEES AND DISBURSEMENTS OF PARCEL OWNERS		PURCHASED UNDER CONTRACT				
	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
								\$19,337.55	\$37,124.84
04	\$242,227.04	\$17,022.78	\$17,022.78	\$16,109.88	\$16,109.88	\$17,550.00	\$22,050.00	\$547,355.65	\$739,755.81
50	21,302.50					9,460.00	9,655.00	82,915.74	85,917.74
50	5,625.00					19,115.00	19,115.00	64,608.83	65,579.03
								18,440.19	18,440.19
								5,644.47	5,644.47
50	177,325.00	11,242.80	12,891.95	13,834.62	17,064.42	430.00	430.00	215,466.33	320,583.87
50	204,252.50	11,242.80	12,891.95	13,834.62	17,064.42	29,005.00	29,200.00	387,075.56	496,165.30
50	45,700.00	3,381.80	3,381.80	1,868.00	1,868.00	3,213.75	3,213.75	176,819.48	216,408.23
50	183,280.00	15,288.93	15,288.93	12,661.25	12,661.25	2,550.00	2,550.00	299,261.81	315,349.49
50	228,980.00	18,670.73	18,670.73	14,529.25	14,529.25	5,763.75	5,763.75	476,081.29	531,757.72
54	\$675,459.54	\$46,936.31	\$48,585.46	\$44,473.75	\$47,703.55	\$52,318.75	\$57,013.75	\$1,429,850.05	\$1,804,803.67

STATE

CLASSIFICATION OF DISBURSEMENTS BY DEPARTMENTS AND DIVISIONS AND TOTAL DISBURSEMENTS
AND FROM JUNE 9, 1905

	SALARIES		PERMANENT EQUIPMENT		CONSUMABLE SUPPLIES	
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
RESERVOIR DEPARTMENT						
Executive.....			\$279.58	\$279.58	\$1,260.24	\$1,260.24
Contract 3—Main Dams.....	\$69,181.67	\$71,025.38	1,142.36	1,142.36	2,654.06	2,654.06
Contract 5—Kingston Sewer.....	267.00	497.00	54.00	54.00	778.70	778.70
Department Totals.....	69,448.67	71,522.38	1,475.94	1,475.94	4,693.00	4,693.00
NORTHERN AQUEDUCT DEPARTMENT						
EXECUTIVE DIVISION.....	5,322.54	6,253.04	2,513.52	2,525.42	753.51	753.51
ESOPUS DIVISION						
Executive.....	3,026.18	3,026.18	913.25	913.25	1,658.68	1,658.68
Contract 12—Rondout Pressure Tunnel...	11,666.92	11,666.92	278.09	278.09	3,050.15	3,050.15
Contract 11—Cut-and-Cover.....	5,402.93	5,402.93			1,977.40	1,977.40
Total.....	20,096.03	20,096.03	1,191.34	1,191.34	6,686.23	6,686.23
WALKILL DIVISION						
Contract 15—Cut-and-Cover.....	262.56	262.56			1,496.42	1,496.42
Contract 47—Walkill Pressure Tunnel....	2,363.07	2,363.07			871.83	871.83
Total.....	2,625.63	2,625.63			2,368.25	2,368.25
PEEKSKILL DIVISION						
Executive.....			11.00	27.56	1,623.22	1,623.22
Contract 2—Cut-and-Cover and Grade Tunnel.....	61,756.17	88,411.99	2,758.51	3,809.63	9,349.84	9,349.84
Total.....	61,756.17	88,411.99	2,769.51	3,837.19	10,973.06	10,973.06
Department Totals.....	89,800.37	117,386.69	6,474.37	7,553.95	20,781.05	20,781.05
ENGINEERING BUREAU Totals.....	\$159,249.04	\$188,909.07	\$7,950.31	\$9,029.89	\$25,474.05	\$25,474.05

*Credit caused by transfer to Agreements

MENT 5

EXPENSES CLASSIFIED, ACCOUNT PERMANENT CONSTRUCTION, DURING THE YEAR 1908,
TO DECEMBER 31, 1908

APPLIES	CONTRACTS		AGREEMENTS		DAMAGES		DIVISION AND DEPARTMENT TOTALS	
	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905	1908	Total from Jun. 9, 1905
260.24 877.08 055.56	\$779,473.11 13,653.22	\$779,473.11 13,653.22					\$1,539.82 852,451.20 14,752.92	\$1,539.82 859,517.93 15,259.78
192.88	793,126.33	793,126.33					868,743.94	876,317.53
008.33							8,589.57	9,786.79
305.48 050.15 977.40	4,415.00 452,280.43 59,292.89	5,445.00 452,280.43 59,292.89	\$4,802.00	\$4,802.00			14,615.11 467,275.59 66,673.22	16,291.91 467,275.59 66,673.22
333.03	515,988.32	517,018.32	4,802.00	4,802.00			548,563.92	550,240.72
496.42 371.83	17,516.34	17,516.34					1,758.98 20,751.24	1,758.98 20,751.24
368.25	17,516.34	17,516.34					22,510.22	22,510.22
100.55	*555.00	11,095.00	18,640.00	18,640.00			19,719.22	34,863.11
385.35	358,698.27	476,880.55					432,562.79	580,487.52
185.90	358,143.27	487,975.55	18,640.00	18,640.00			452,282.01	615,350.63
195.51	891,647.93	1,022,510.21	23,242.00	23,242.00			1,031,945.72	1,197,888.36
188.39	\$1,684,774.26	\$1,815,636.54	\$23,242.00	\$23,242.00			\$1,900,689.66	\$2,074,205.89

STATE

SHOWING ESTIMATED LIABILITIES OUTSTANDING AS OF DECEMBER 31, 1908, ON ACCOUNT OF WATER SUPPLY, CITY OF NEW YORK, PURSUANT TO

REGISTERED

CONTRACT NUMBER	NAME OF CONTRACTOR	ESTIMATED COST	AMOUNT PAID ON ACCOUNT	A R
38	HEADQUARTERS DEPARTMENT			
B-Cl. A.	The Snare & Triest Company.....	\$105,678.00	.....	.....
B-Cl. B.	Technical Supply Company.....	3,804.09	.....	.....
B-Cl. C.	The J. W. Pratt Company.....	1,789.18	.....	.....
B-Cl. D.	Continental Playing Card Co.....	1,876.05	.....	.....
	Joseph N. Early.....	3,710.51	.....	.....
3	RESERVOIR DEPARTMENT			
	MacArthur Brothers Co. and Winston & Company.....	12,669,775.00	\$779,473.11	
	NORTHERN AQUEDUCT DEPARTMENT			
	ESOPUS DIVISION			
6	John J. McLean.....	8,965.00	5,445.00	
11	Stewart-Kerbaugh-Shanley Co.....	2,368,920.00	53,219.69	
12	The T. A. Gillespie Company.....	6,290,803.50	458,353.63	
	WALLKILL DIVISION			
15	Elmore & Hamilton Contracting Co.....	933,867.50	17,516.34	
	HUDSON RIVER DIVISION			
1	Phoenix Construction Co., Assignee of American Diamond Rock Drill Co.....	195,000.00	94,316.30	
	PEEKSKILL DIVISION			
2	Thomas McNally Company.....	4,126,423.00	476,880.55	
		\$26,710,611.83	\$1,855,204.62	

SPECIAL A

AGREEMENT NUMBER	AGREEMENT MADE WITH	ESTIMATED COST	AMOUNT PAID ON ACCOUNT
37	NORTHERN AQUEDUCT DEPARTMENT		
68	Cranford Company.....	\$450,000.00	\$78,754.24
72	Louis H. DuBois.....	7,000.00	2,436.59
	J. S. Mundy.....	11,472.00	.....
70	SOUTHERN AQUEDUCT DEPARTMENT		
71	Toney Richards.....	5,000.00	4,567.25
	William M. Quinby.....	5,600.00	1,892.80
		\$479,072.00	\$87,650.88

MENT 6

INT OF REGISTERED CONTRACTS AND SPECIAL AGREEMENTS EXECUTED BY THE BOARD T TO SECTION 34, CHAPTER 724, LAWS OF 1905

CONTRACTS

OUNT PAID	AMOUNT EARNED	ESTIMATED LIABILITY	DESCRIPTION OF CONTRACT	DATE OF CONTRACT
		\$105,878.00	Borings south of Hill View reservoir.....	Dec. 1, '08
		3,804.09	Furnishing supplies.....	Sep. 16, '08
		1,789.18	Furnishing supplies.....	Sep. 16, '08
		1,876.05	Furnishing supplies.....	Sep. 14, '08
		3,710.51	Furnishing supplies.....	Sep. 14, '08
\$,808.12	\$866,081.23	11,890,301.89	Construction of main dams of Ashokan reservoir...	Sep. 5, '07
605.00	6,050.00	3,520.00	Construction of field office.....	Jun. 2, '08
5,913.30	59,132.99	2,315,700.31	Construction of cut-and-cover aqueduct.....	Aug. 5, '08
0,928.18	509,281.81	5,832,449.87	Construction of Rondout pressure tunnel.....	Jun. 12, '08
1,946.26	19,462.60	916,351.16	Construction of cut-and-cover aqueduct.....	Sep. 9, '08
0,479.58	104,795.88	100,683.70	Test-borings in Hudson river.....	Mar. 1, '06
2,986.73	529,867.28	3,649,542.45	Construction of cut-and-cover aqueduct and grade tunnel.....	Apr. 10, '07
\$,467.17	\$2,094,671.79	\$24,825,407.21		

EMENTS

ESTIMATED LIABILITY	DESCRIPTION OF AGREEMENT	DATE OF AGREEMENT
\$371,245.76	Test shafts on shores and in the bed of Hudson river.....	Feb. 23, '07
4,563.41	Wash borings, test-pits and soundings in Ulster and Orange Cos.....	May 1, '08
11,472.00	Renting of two hoisting engines and a boiler plant for putting down test shafts and making borings therefrom beneath Hudson river, Town of Cornwall, Orange Co., and Town of Fishkill, Dutchess Co.....	Dec. 7, '08
432.75	Test-pits in Westchester Co.....	Jun. 6, '08
3,707.20	Test-borings in rock in Westchester Co.....	Sep. 8, '08
\$391,421.12		

STATEMENT 6-A

COMPLETED CONTRACTS AND AGREEMENTS

CONTRACTS

CONTRACT NUMBER	NAME OF CONTRACTOR	COMPLETED COST	YEARLY TOTALS	DESCRIPTION OF CONTRACT	DATE OF CONTRACT
4	Daniel Carpenter.....	\$11,095.00		Construction of field office building in the town of Cortlandt, Westchester Co., N. Y.....	Aug. 12, '07
5	Hegerty Contracting Company.....	13,653.22		Construction of a portion of an intercepting sewer in the City of Kingston, N. Y.....	Sep. 19, '07
A	The J. W. Pratt Co.....	1,713.52		Printing and delivering the first annual report.....	May 1, '08
	Total from June 9, '05 to Dec. 31, '08		\$26,461.74		

AGREEMENTS

AGREEMENT NUMBER	AGREEMENT MADE WITH	COMPLETED COST	YEARLY TOTALS	DESCRIPTION OF AGREEMENT	DATE OF AGREEMENT
1	F. W. Miller.....	\$4,955.00		Wash borings in Hudson river.....	Sep. 11, '05
2	F. W. Miller.....	14,092.80		Test-borings in channel and on shores of Hudson river.....	Oct. 27, '05
3	Henry Romelke, Inc.....	82.97		Press clippings.....	Sep. 14, '05
4	United Engineering and Const. Co.....	10,243.77		Test-borings in rock on both shores of Hudson river.....	Sep. 14, '05
5	James E. O'Neill.....	50.00		Furnishing copies of bills introduced in 1906 Legislative session.....	Nov. 8, '05
10	Sprague and Henwood.....	6,572.56		Core borings in Ulster Co.....	May 4, '06
19	F. W. Miller.....	6,718.20		Wash borings in channel of Hudson river.....	Jun. 26, '06
	Total for year 1906.....		\$42,684.40		
6	F. W. Miller.....	819.00		Wash borings in Dutchess Co.....	May 4, '06
7	F. W. Miller.....	7,816.59		Wash borings in Ulster Co.....	May 4, '06
8	Healey Sewer Machine and Const. Co.....	8,061.58		Wash borings in Putnam and Westchester Cos.....	May 4, '06
9	Healey Sewer Machine and Const. Co.....	11,969.39		Core borings in Putnam and Westchester Cos.....	May 17, '06
11	United Engineering and Const. Co.....	21,379.50		Core borings in Dutchess Co.....	Jun. 6, '06
12	Sprague and Henwood.....	21,353.59		Test-borings in rock at dam site, Ashokan reservoir.....	Jun. 6, '06
13	Naughton Co.....	32,850.39		Shafes and trenches, proposed dam site, Ashokan reservoir.....	Jun. 6, '06
14	Turner Construction Co.....	5,164.33		Test sections of aqueduct erected at 79th Street, North river.....	Jul. 12, '06
15	F. W. Miller.....	1,732.00		Wash borings in Orange, Putnam and Westchester Cos.....	Jul. 12, '06
16	Sprague and Henwood.....	12,443.50		Core borings in Ulster Co. east of Shawangunk mountains.....	Jul. 25, '06
17	Sprague and Henwood.....	34,867.50		Core borings in Ulster Co. west of Shawangunk mountains.....	Jul. 25, '06

STATEMENT 6-A (Concluded)

18	George M. Lyon.....	-4,519.50	Core borings in Orange Co.....	Aug. 1, '06
20	William M. Quimby.....	6,300.00	Test-borings at proposed dam site, Kenisco reservoir.....	Sep. 13, '06
21	W. G. Stearns.....	12,328.75	Test-borings into rock along proposed Catskill aqueduct.....	Oct. 23, '06
23	J. W. Randall.....	3,579.95	Core borings along proposed Catskill aqueduct.....	Oct. 24, '06
24	Roy S. Barker.....	1,884.75	Core borings in Orange Co.....	Oct. 24, '06
25	John J. Walsh.....	1,277.87	Test-pits in Putnam Co.....	Oct. 24, '06
26	Walter E. Clark.....	1,986.79	Test-pits along the line of Wallkill division, Catskill aqueduct.....	Nov. 7, '06
27	Brynn Hasbrouck.....	3,351.09	Test-borings in easterly portion of Suffolk Co.....	Nov. 7, '06
28	Roy S. Barker.....	2,186.85	Test-borings in sand, gravel and clay in Suffolk Co.....	Nov. 7, '06
29	F. W. Miller.....	1,031.56	Test-borings into rock at proposed dam site, Kenisco reservoir.....	Jan. 4, '07
30	Roy S. Barker.....	9,283.70	Test-borings into rock at proposed dam site, Kenisco reservoir.....	Jan. 24, '07
31	William M. Quimby.....	14,960.64	Test-borings in Sprout Brook and Peekskill Creek valleys.....	Jan. 30, '07
32	Healey Sewer Machine and Const. Co.....	2,390.62	Test-borings in rock at proposed dam site, Kenisco reservoir.....	Feb. 1, '07
33	United Engineering and Const. Co.....	2,453.25	Test-wells in Suffolk Co.....	Feb. 1, '07
34	F. W. Miller.....	240.00	Test soundings in bed of Hudson river, near Cornwall.....	Feb. 19, '07
35	American Diamond Rock Drill Co.....	16,753.39	Experimental tunnels into rock along Catskill aqueduct near High Falls.....	Mar. 4, '07
36	Naughton Co.....	752.40	Construction of six weirs in southerly portion of Suffolk Co.....	Apr. 6, '07
39	W. Eoe Jones and B. B. Wood.....	4,997.63	Test-borings along Catskill aqueduct in Peekskill Creek valley.....	Apr. 6, '07
41	J. W. Randall.....	3,680.00	Test-borings in New York Harbor between Long Island and Staten Island.....	May 20, '07
42	F. W. Miller.....	25,000.00	Purishing and laying riveted steel pipes in Olive Township, Ulster Co.....	May 20, '07
46	T. A. Gillespie Co.....	5,950.36	Test-borings in rock along proposed Catskill aqueduct.....	May 20, '07
47	J. A. Gordon and M. F. Mudge.....	1,989.35	Test-wells in sand, gravel and clay, Suffolk Co.....	May 20, '07
48	F. W. Miller.....	4,268.46	Shafts and trenches, proposed dam site, Kenisco reservoir.....	May 20, '07
49	Naughton Co.....	3,389.56	Test-pits along Catskill aqueduct in Orange, Dutchess and Westchester Cos.....	Jul. 6, '07
51	John J. Walsh.....	3,273.70	Test-borings into rock along Catskill aqueduct.....	Jul. 6, '07
52	Arthur L. Washburne.....	746.00	Purishing machine and tools for pumping tests along Catskill aqueduct.....	Aug. 7, '07
57	E. J. Sanders.....	2,020.66	Test-wells in sand, gravel and clay, Suffolk Co.....	Sep. 6, '07
64	F. W. Miller.....	1,418.04	Test-wells in sand, gravel and clay, Suffolk Co.....	Sep. 6, '07
65	Manhattan Drilling Co.....			
	Total for year 1907.....	\$280,248.05		
22	C. H. McCarthy.....	27,581.69	Core borings at Foundry Brook, Putnam Co.....	Oct. 18, '06
38	F. W. Miller.....	7,168.50	Wash borings in Westchester Co.....	Apr. 15, '07
40	George M. Lyon.....	19,188.51	Test-borings in rock in Orange Co.....	Apr. 15, '07
43	Naughton Co.....	24,195.20	Test sections of reinforced concrete pipes near Hunter's Brook, Yorktown Township, Westchester Co.....	May 25, '07
44	Sprague and Henwood.....	101,174.67	Test-borings in rock territory north of Hill View reservoir.....	Apr. 18, '07
45	Germanatown Artesian Well Co. (F. Rockefeller).....	16,520.10	Test-borings along Catskill aqueduct, Orange Co.....	Jun. 1, '07
50	Brynn Hasbrouck.....	3,970.03	Test-pits in Ulster and Orange Cos.....	Jun. 1, '07
53	Madison Building Co.....	4,100.00	Alterations and additions to "Rich House" town of Cortlandt, Westchester Co.....	Aug. 13, '07
54	Madison Building Co.....	4,775.00	Construction of Section office No. 3, Town of Philipstown, Putnam Co.....	Aug. 13, '07
55	Madison Building Co.....	4,775.00	Construction of Section office No. 4, Town of Philipstown, Putnam Co.....	Aug. 13, '07
56	Madison Building Co.....	4,990.00	Construction of Section office No. 5, Town of Philipstown, Putnam Co.....	Sep. 8, '07
59	John J. Wilson.....	4,484.00	Construction of field office building in Marbletown, Ulster Co.....	Sep. 8, '07
66	Harry M. Ripley.....	6,499.60	Test-borings in rock in Westchester Co.....	Nov. 15, '07
67	Arthur L. Washburne.....	14,884.80	Test-borings in rock in Westchester Co.....	Nov. 15, '07
	Total for year 1908.....	244,307.10		
	Total from June 9, '05 to Dec. 31, '08.....	\$667,359.55		

*Cancelled by Chief Engineer

REPORT OF THE CHIEF ENGINEER

NEW YORK, December 31, 1908.

BOARD OF WATER SUPPLY,
299 Broadway, New York City.

GENTLEMEN:

The following is a report of the operations of the Engineering Bureau for the year ended December 31, 1908. The general organization of the Engineering bureau has remained the same as last year. The engineers reporting directly to the Chief Engineer are as follows:

Alfred D. Flinn, Department Engineer, Headquarters department.

Carleton E. Davis, Department Engineer, Reservoir department.

Robert Ridgway, Department Engineer, Northern Aqueduct department.

Merritt H. Smith, Department Engineer, Southern Aqueduct department.

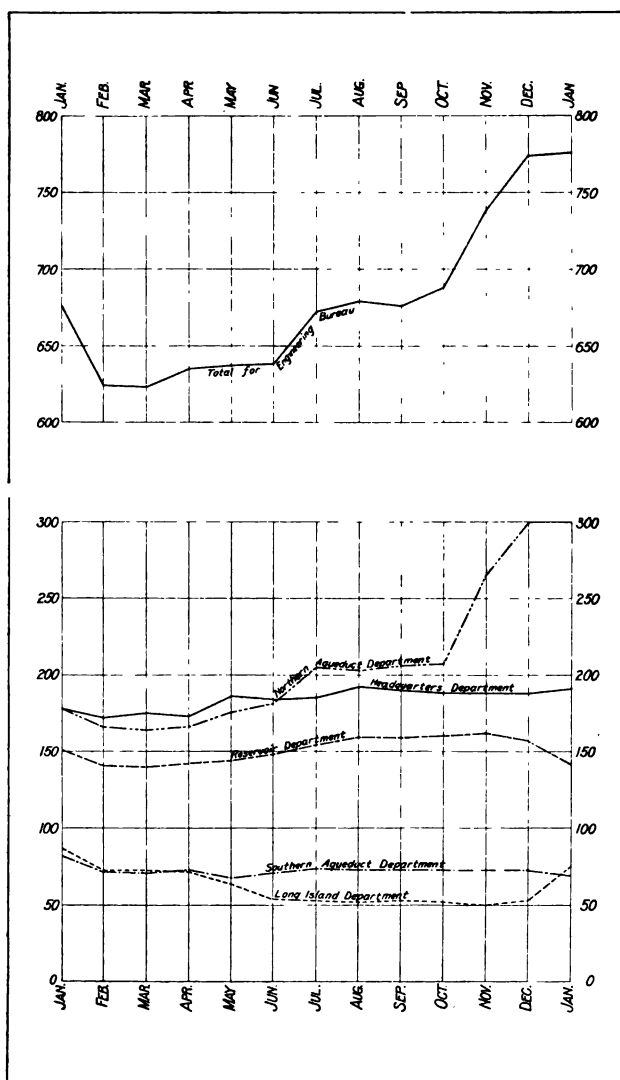
Walter E. Spear, Division Engineer, Long Island department.

John R. Freeman, William H. Burr and Frederic P. Stearns have acted as a board of consulting engineers.

The location of the aqueduct line having been approved by the State Water Supply Commission in 1906, the preparation of work for contract was continued. Contract 12, for the Rondout pressure tunnel, was entered into June 12, 1908, with The T. A. Gillespie Company, of New York, and provides for the construction of about 4 miles of work in the Esopus division of the Northern Aqueduct department. The estimated cost of the work under this contract is \$6,290,803.50.

Contract 11, for the Esopus cut-and-cover, was entered into August 5, 1908, with the Stewart-Kerbaugh-Shanley Company of New York, and provides for the construction of about 7 miles of cut-and-cover and grade tunnel in the Esopus division of the Northern Aqueduct department. The estimated cost of the work under this contract is \$2,368,920.00.

Contract 15, for the Wallkill south cut-and-cover, was entered into September 9, 1908, with The Elmore and Hamilton Contracting Company of Albany, and provides for the construction



FLUCTUATIONS IN ENGINEERING FORCE DURING 1908.

of about 3 miles of cut-and-cover aqueduct in the Wallkill division of the Northern Aqueduct department. The estimated cost of the work under this contract is \$933,867.50.

By the end of the year 10 other contracts, covering 26.7 miles of work, were entirely prepared and ready for advertising.

Owing to several collisions with river craft, no definite results were obtained from the boring work at the Storm King crossing of the Hudson river. The deepest hole near the center of the river reached Elevation-626, without encountering rock. Two other holes nearer the shore found rock and so a gap of only 1,200 feet in width is left unexplored. The sinking of the test-shafts at the river crossing was taken up by day labor and preparations to obtain and instal the necessary plant were pushed forward.

HEADQUARTERS DEPARTMENT

ALFRED D. FLINN, *Department Engineer*

ORGANIZATION

DIVISIONS AND EMPLOYEES

During the year the organization remained unchanged, with the exception that a Distribution division was organized to determine the types, locations and sizes for the extensions of the Catskill aqueduct to the various boroughs of The City. William W. Brush was placed in charge of this work. Alton T. Roberts, Chief Clerk of the Engineering bureau, resigned on November 30, 1908, and W. J. Buhrendorf was transferred from the Northern Aqueduct department to fill the vacancy. Comparison is shown in the following summary of the force during 1907 and 1908:

FORCE IN HEADQUARTERS DEPARTMENT

	1907	1908
January 1.....	87	171
December 31.....	171	183
Maximum.....	177	192 (Aug. 10)
Minimum.....	87	171 (Feb. 3)

CIVIL SERVICE

On January 1 the force of the Engineering bureau totaled 676. The minimum was 620, March 25, and the maximum 776, December 31. Table 15 is a schedule of employees at the last-mentioned

date, and page 61 shows the fluctuation during the year. Following is a summary of appointments for the year:

APPOINTMENTS DURING 1908

	MADE	RESCINDED
Exempt class.....	2	..
Non-competitive class.....	2	..
Competitive class.....	240*	14
Labor class.....	59	8
Total.....	303**	22

*Includes appointments from eligible lists certified by the Municipal Civil Service Commission, appointments by transfer from other Municipal departments and excepted from competitive examination, pursuant to Rule XII, Paragraph 7, Civil Service regulations, applying to appointees for service in a locality outside of the City.

**Includes temporary and permanent appointments.

Separations from the force totaled 181; by resignation 55, by transfer 25, by dismissal 17, and various 84.

Examinations were held by the Municipal Civil Service Commission during the year to anticipate and fill the requirements of the Engineering bureau as follows:

Laborer in Orange county, 70 applicants.

Stenographer and Typewriter, 2d grade (male), October 30 and November 7, 132 applicants, salary \$600 and \$1,050, for assignment outside of the City of New York; minimum age, 18 years.

Typewriting Copyist, 2d grade (male and female), November 4 and 7, 208 applicants, salary \$600, for assignment outside of the City of New York; minimum age, 18 years.

Clerk, 2d grade (male), November 6, 9, 13 and 18, 2,876 applicants, salary \$600 and \$900, for assignment outside of the City of New York; minimum age, 18 years.

Inspector, November 20, 542 applicants, salary \$4.50 and \$5.00 per day; minimum age, 22 years.

Pending establishment of eligible lists from the foregoing examinations, the following temporary appointments were made:

4 Temporary Stenographers and Typewriters

3 Temporary Typewriting Copyists

8 Temporary Clerks

LABORATORY

The principal addition to the laboratory equipment was a petrographic microscope for the study of building stones, concrete aggregates and road materials. Routine work in the photographic, physical and chemical laboratories was carried on during the year.

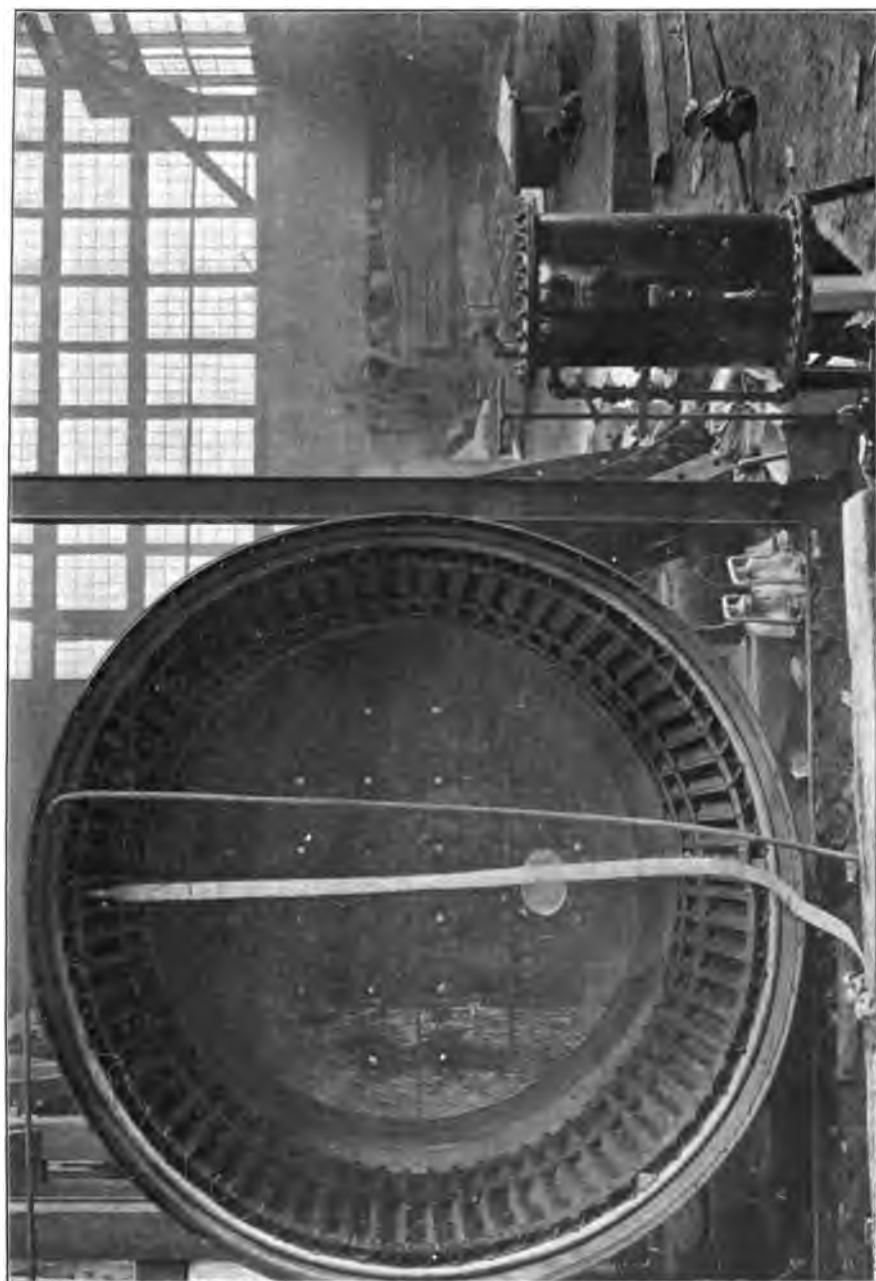
SUMMARY OF YEAR'S WORK

During the year the force was engaged in perfecting designs, in preparing contracts, plans and specifications, and in making adjustments arising from changes made in the field and more complete information regarding the various structures. Designs and specifications, particularly those for the several types of aqueduct, were made general, so that future contracts can be prepared from them, with detail attention only to special features.

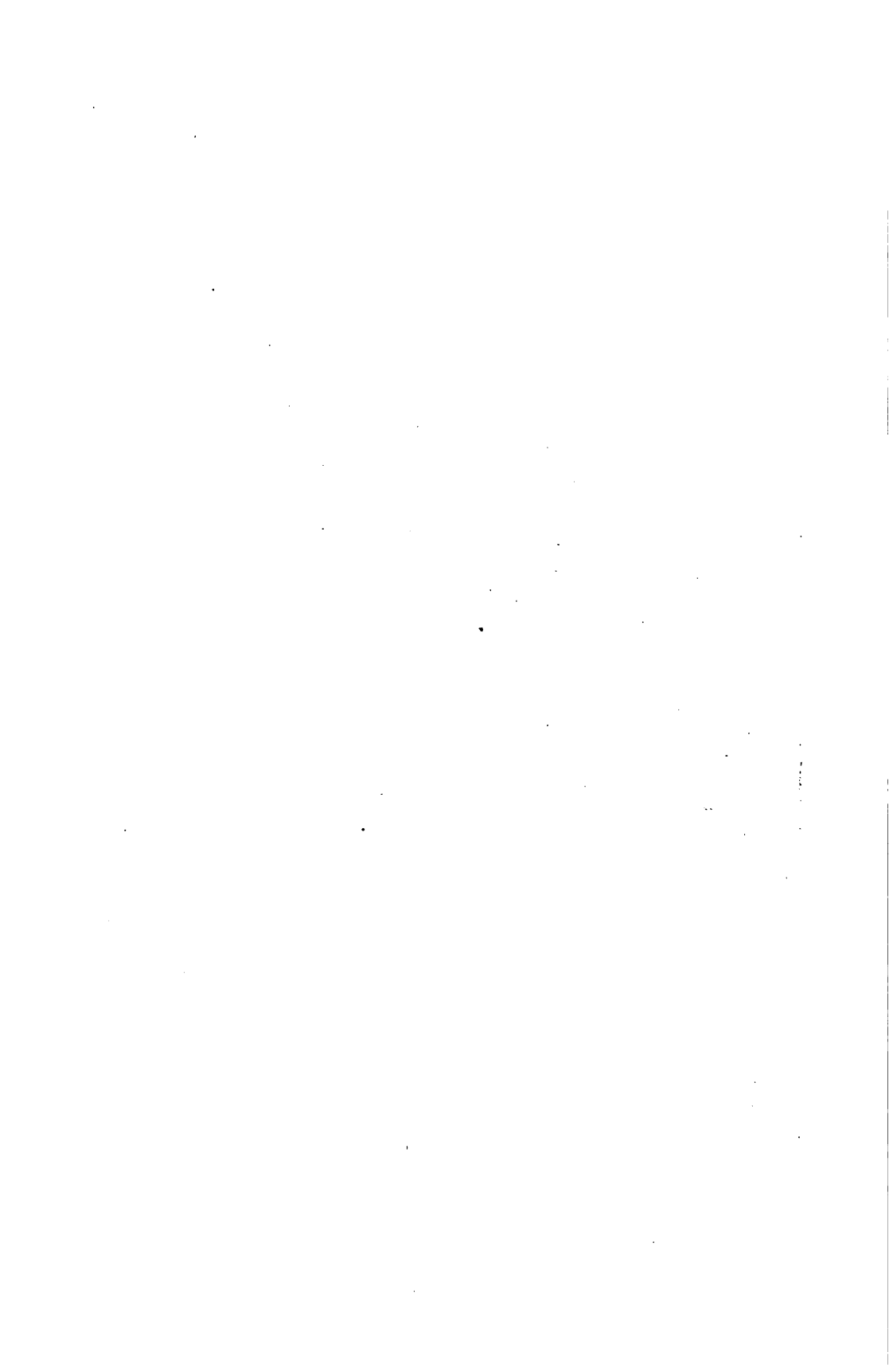
Contract 9, for the construction of the Kensico dam was practically completed. Designs for a reservoir at Hill View were well advanced, and the first draft of the specifications, Contract 30, was prepared.

Gradient studies of the Catskill aqueduct were continued, and resulted in determining the sizes of the steel pipe siphons and in fixing the elevations of various portions of the aqueduct.

Crossing the Hudson at or near Storm King by means of suspension or other bridge, submerged pipes, shallow pneumatic tunnel or deep pressure tunnel in rock was studied with further evidence of the great economy of the pressure tunnel in rock. Provision was made for continuing the test shafts, abandoned under Agreement 37, and running inclined diamond drill borings in advance of the tunnel beneath the river at various depths. Steel pipe was adopted for deep siphons not to be constructed as pressure tunnels in rock. Successful experiments with mortar-lined steel pipes demonstrated the feasibility of this form of construction and its probable advantages over ordinary coated pipes. Further observations upon existing steel pipes showed that three lined pipes were practically equivalent in capacity to four unlined pipes. Accordingly, three lined pipes for each siphon were adopted as standard construction. Studies for the extension of the Catskill aqueduct to the various City boroughs were also made and work under a contract for drill borings along the proposed lines was begun in December.



CATSKILL AQUEDUCT—Experiments on Mortar Lining of Steel Pipes. Steel Forms inside of Pipe ready for filling 2-inch space between Forms and Pipe with Cement Grout. Grouting Pressure Tank beside Pipe.



DESIGN OF STRUCTURES

ASHOKAN RESERVOIR

Detailed working drawings were prepared from time to time as the progress of construction under Contract 3 required for the main dams.

DIVIDING WEIR BRIDGE

Designs were in progress for a reinforced concrete bridge over the dividing weir to connect the highway that crosses the Olive Bridge dam from the south shore of the reservoir with that on the north. In the southerly abutment of the bridge provision has been made for a gate-chamber to contain four 5 by 15-foot sluice-gates, thus affording a direct connection between the two basins of the reservoir at low levels. The total length of the bridge is 1,000 feet, and it has been designed with fifteen spans of equal length.

UPPER GATE-CHAMBER

Working drawings for the upper gate-chamber were prepared as needed. Particular attention was given to the desirability of occasionally controlling by the gates in the upper chamber the water to be delivered to the Catskill aqueduct. Ordinarily this flow will be controlled in the lower gate-chamber. To facilitate control, the guard gates at the bottom of the upper chamber have been designed as rectangular sluice-gates.

KENSICO RESERVOIR

General. Lake Kensico, formed by the present Kensico dam, is a small reservoir supplying an important section of high ground in the Borough of The Bronx, through a 48-inch pipe-line known as the Bronx conduit, the system being known as the Williamsbridge service. To avoid interrupting this supply, a location for the Kensico dam down stream, though very near the present dam, had been fixed in 1907. Further study, during the first months of 1908, showed that the supply to Bronx conduit could be better and more cheaply maintained by building substitute supply works, farther up the valley, to take the place of Lake Kensico, thus permitting the Kensico dam to be built more economically and in a much more satisfactory location just above the present dam.

Substitute Supply Works. The substitute supply works will include the New Rye reservoir with a water surface of 650 acres and a total capacity of 4,900 million gallons, formed by the construc-

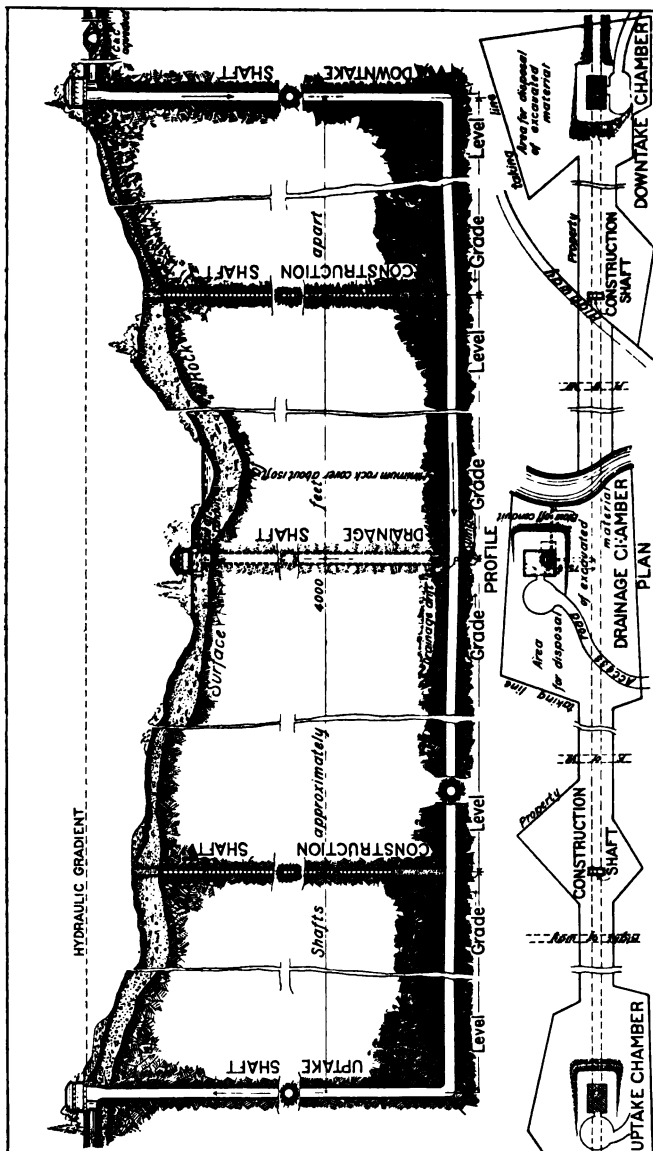
tion near Kensico village of New Rye dike, an earth embankment 475 feet in length, with a maximum hight of 50 feet; an earth dike on the Bronx river 460 feet long, with a maximum hight of 50 feet, creating a basin of 67 acres and 160 million gallons capacity; a tunnel 625 feet long in earth and rock, through which the Bronx river will be diverted into the New Rye reservoir, and a 36-inch riveted steel pipe-line, about 11,000 feet in length, connecting the New Rye reservoir with the Bronx conduit below the present dam. A concrete gate-chamber and aeration works will be built at the head of the pipe-line and a pressure controller, consisting of a simple overflow, will be installed. To insure a good quality of water, the reservoir bottoms will be cleared, some swampy portions will be stripped and other portions covered with sand or earth containing little or no organic matter.

As a precaution against accident, a pumping outfit, consisting of two 225-horse-power boilers and two steam turbo-driven, turbine pumps, capable of delivering 25 million gallons of Croton water to the Williamsbridge reservoir, or 12½ million gallons to the high-service mains of The Bronx, was designed for installation in the Jerome avenue pumping station. Complete contract drawings and specifications were prepared. This plant will also serve as a contemplated addition to this station.

KENSICO DAM

General Description. Kensico dam, as designed, is a masonry structure, about 1,830 feet in length, extending across the Bronx river valley. With a maximum hight of about 170 feet above the present river bed, its foundations will extend to solid ledge-rock, 120 feet or more below the surface at the deepest point. It will be built of cyclopean masonry with a cross-section similar to that of the Olive Bridge dam. Expansion-joints, drainage wells and transverse galleries, similar to those of the Olive Bridge dam described in last year's report, are provided.

Gate-Chamber and Connection with Bronx Conduit. In order to provide for the future permanent maintenance of the supply to the Bronx conduit and for its probable increase, a connection will be made through gate-chambers located in the center of the dam. A 60-inch pipe will lead from the gate-chamber to a drainage outlet and will be connected by means of a 36-inch pipe with the Bronx conduit. The 60-inch pipe will serve at first as a blow-off and later as a conduit for future additional supply.



CATSKILL AQUEDUCT—Typical pressure tunnel.

RYE OUTLET BRIDGE

Kensico reservoir will submerge the State highway extending along the easterly shore of Lake Kensico and along Bear Gutter, and necessitate the substitution of about 4 miles of new highway. To carry this highway across a narrow portion of the reservoir, various types of bridges were studied. A reinforced concrete bridge, with approaches each 110 feet long and five segmental arch spans of 24-foot rise, varying in length from 125 feet at the ends to 129 feet at the center, was determined upon. Each arch will consist of two ribs carrying open spandrels. The maximum height above the bottom of the reservoir will be 100 feet. The roadway, 22 feet wide, will be supported upon a reinforced concrete floor.

GENERAL

Preliminary designs were made and specifications prepared for a group of structures near Kensico reservoir for the control and circulation of water entering, leaving or by-passing the reservoir, and for the aeration of this water. These structures embrace the influent weir, over which water enters the reservoir from the Catskill aqueduct, the influent chamber for control of flow into the by-pass aqueduct, the upper and lower effluent chambers for controlling the discharge from the reservoir, the by-pass aqueduct along the margin of the reservoir between the influent and upper effluent chambers, the aeration plant, Kensico dike, the screen chamber and portions of a 17-foot reinforced concrete aqueduct leading to the Eastview filter site, including also a Venturi meter and the Kensico tunnel.

HILL VIEW RESERVOIR

Designs for the 900-million-gallon equalizing reservoir at Hill View, Contract 30, are well advanced, and the first draft of the specifications was prepared.

CATSKILL AQUEDUCT

HYDRAULIC GRADIENT

Hydraulic gradient studies for the Catskill aqueduct north of Kensico reservoir resulted in fixing the lengths and sizes of the steel pipe siphons. A steepening in the gradient north of the Rondout siphon was made in order to compensate for the increased fouling which occurs at the up-stream end of an aqueduct, and a final ad-

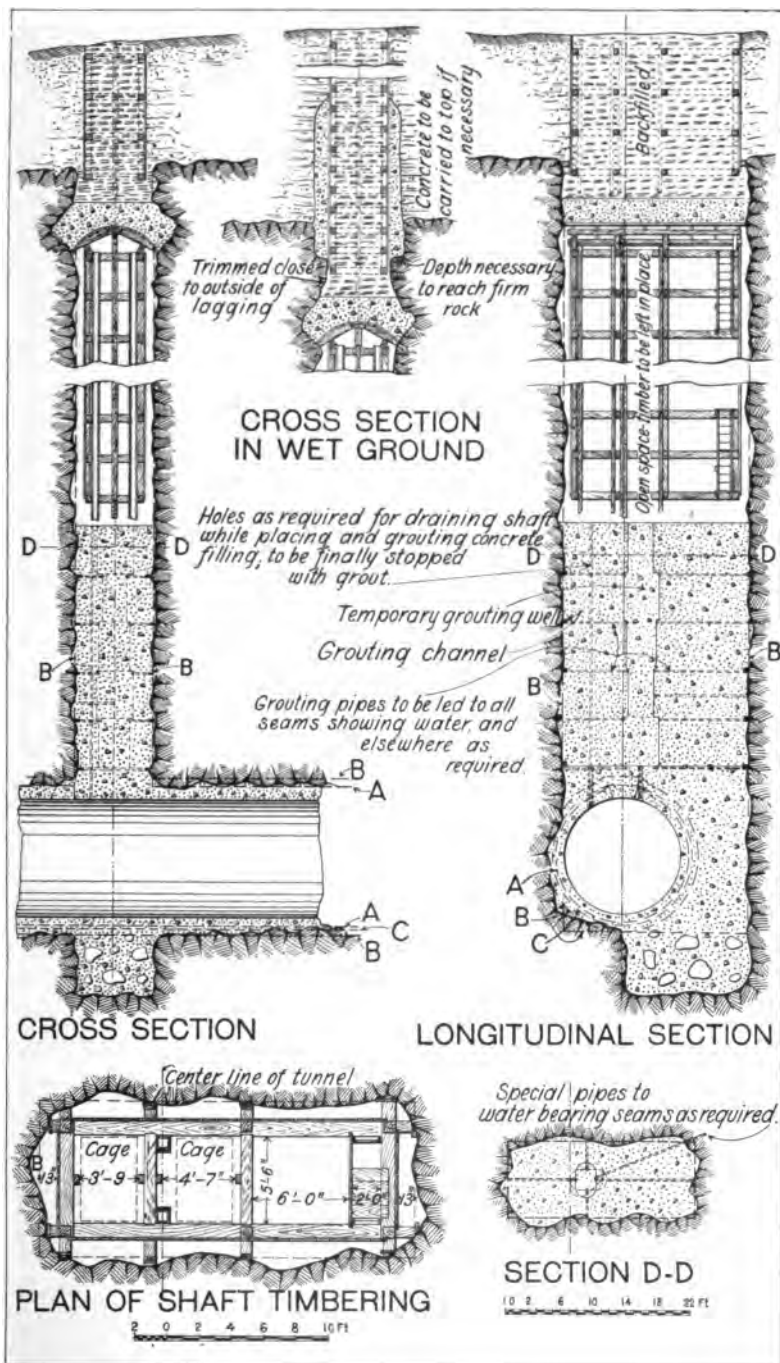
justment of the gradient from Hunters brook to Kensico reservoir was made. This last involved a reconsideration of the elevation at which the aqueduct enters Kensico reservoir, on account of a provision for flashboards on Kensico waste-weir, making possible the raising of the water level 2 feet or more above Elevation 355, the previously assumed high-water mark. The water surface in the aqueduct when flowing 0.9 full was fixed at Elevation 354.17 at the reservoir, or 354.47 just above the inlet gate-house and possible heads on the aqueduct are provided against by overflows.

Between Kensico and Hill View reservoirs the gradient was tentatively established subject to a few final adjustments. For the subgrade of the East view filters Elevation 311 was fixed upon and for high water in Hill View reservoir Elevation 295. It was decided to depress the aqueduct between Kensico reservoir and the filters so that the reservoir can be drawn 10 feet lower with the filters out of service. With the filters in service, the aqueduct between them and Kensico reservoir will therefore be under a head of about 10 feet.

BLOW-OFFS AND OVERFLOWS

In 1907 it was decided to provide blow-offs capable of intercepting the maximum flow of Catskill aqueduct at Croton lake, at the Hudson river, and possibly in the stretch of cut-and-cover aqueduct south of Wallkill siphon. For the blow-off at Croton lake a design was worked out in connection with the downtake chamber of the Croton lake siphon by which the full flow of the aqueduct may be discharged through a 60-inch pipe branching from the downtake shaft about 71 feet below the aqueduct invert and continuing through a tunnel and conduit into the New Croton lake. Two 60-inch hydraulic valves, set tandem so that either can be opened for testing without allowing the escape of any appreciable quantity of water, will control the flow. This blow-off conduit will also serve as a connection between the Catskill aqueduct and the Croton system and as a channel for the overflow weir.

Studies were made to determine the head at various points on the aqueduct north of Kensico reservoir resulting from fixing the 0.9 flow line of the aqueduct at Kensico reservoir at Elevation 354.17, several feet below possible extreme high water and to devise methods of preventing excessive pressures if, when the end of the aqueduct is submerged, an attempt be made to run through it more water than it will carry when flowing full. As a precautionary measure, an overflow weir will be installed at Croton lake siphon



CATSKILL AQUEDUCT—Typical pressure tunnel construction shaft.

with its crest at the 0.9 depth of the aqueduct, and another overflow will also be placed near the Hudson siphon. Provision was also made for an overflow at the downtake chamber of the Rondout siphon.

HEADWORKS

Designs and specifications for the headworks of the Catskill aqueduct, Contract 10, were well started. The structures involved are: the Ashokan lower gate-chamber, an aerator, a waste channel, a screen chamber, a Venturi meter and about one mile of aqueduct extending to the Esopus siphon, including a stretch of special design between the lower gate-chamber and the screen chamber. In the lower gate-chamber power for lighting, for operating gates and for other local uses will be generated. This chamber is so designed that it may be extended at either end in the event of further power development. The aqueducts, designed to permit water to flow from the lower gate-chamber directly to the Catskill aqueduct or by way of the aeration pool, contain waste-weirs for preventing the water from rising to undesirable elevations below the screen chamber. These weirs can also be used for wasting water in case it is desired to empty either or both basins of Ashokan reservoir. A Venturi meter capable of measuring the entire flow of the aqueduct will be constructed a short distance below the screen chamber.

SANITARY PRECAUTIONS IN CROTON WATERSHED

Necessity for special precautions on work within the Croton water-shed, to protect The City's water-supply, was early recognized. Specifications were prepared which require extreme care in the control of employees and camps and the thorough destruction or treatment of all wastes and drainage. Preliminary designs were made for sanitary works in Contract 24, including drains, settling basins, filters and incinerators.

CUT-AND-COVER AQUEDUCT

Designs were perfected for the compact earth type of aqueduct construction in which the arch thrusts directly against the undisturbed side of a properly shaped trench in suitable firm earth. Designs were also made for culverts and for a gaging manhole.

Designs for Contracts 13 and 32, for the Wallkill north cut-and-cover, included several large culverts and a skew arch bridge of about 38-foot span, to carry the aqueduct over the gorge at Poor

Farm brook. Under Contract 17, St. Elmo cut-and-cover, designs and specifications were completed for the St. Elmo siphon. At this point the aqueduct will be depressed for about 17 feet below hydraulic grade for a short distance, in order to pass under the right-of-way of the Central New England railroad.

Under Contracts 19 and 33, for the Orange cut-and-cover, an embankment type was designed for a long high fill. The standard embankment was modified so as to contain a slightly larger proportion of rolled material, and a berm was introduced at about invert elevation, the slopes below the berm being flattened.

The only special design required in Contract 22, which includes the Bull hill cut-and-cover, was a large culvert at Breakneck brook. Disposal of spoil was studied so as to provide, without additional cost, a suitable foundation for a temporary filtration plant for use in the event of an emergency water-supply being developed in the vicinity. For Contract 23, embracing portions of the Yorktown cut-and-cover, designs were made for a structure to carry a stream over the top of the aqueduct.

GRADE TUNNELS

For grade tunnels in the Southern Aqueduct department the standard sections determined in previous years were applicable north of Kensico reservoir. The decision to build the aqueduct between Kensico reservoir and Eastview filters at such a level as to put it under a 10-foot head when the filters are in operation necessitated a type of construction capable of withstanding internal pressure and increased external head for Lakehurst, Dike, Kensico, Eastview and Elmsford tunnels.

PRESSURE TUNNELS

The principal types of pressure tunnels having been fixed in 1907, the work during 1908 consisted, in addition to preparing contracts, in perfecting certain details and more particularly in completing studies of shaft sinking methods. These studies resulted in the belief that the European method, which involves the building of permanent masonry lining instead of temporary timbering, was most economical and best adapted for permanent shafts.

STEEL PIPE SIPHONS

With the determination that the Bryn Mawr siphon, on account of great depth and poor quality of rock, will be steel pipe, the list

of steel pipe siphons for Catskill aqueduct was determined. An investigation was made during the year in relation to the use of mortar lining and concrete covering for steel pipes. The results are stated under "Tests and Experiments." When the study of steel pipes was begun, costs of pipes lined with mortar and surrounded with concrete were compared with pipes not so protected, and hence subject to more rapid corrosion, resulting in greater deterioration in capacity. Costs were found about equal for equal carrying capacity. Early in 1908 it was decided, as the outcome of extended observations, to use in the Chezy formula for flow of water in pipes a coefficient of 80 or 85, depending upon the velocity, for unlined steel pipes, instead of 96, previously adopted. On this basis it was found that three lined and covered pipes would give about the same capacity as four unlined pipes. Three lined and covered pipes for each siphon were therefore adopted as the standard form of construction.

EASTVIEW FILTERS

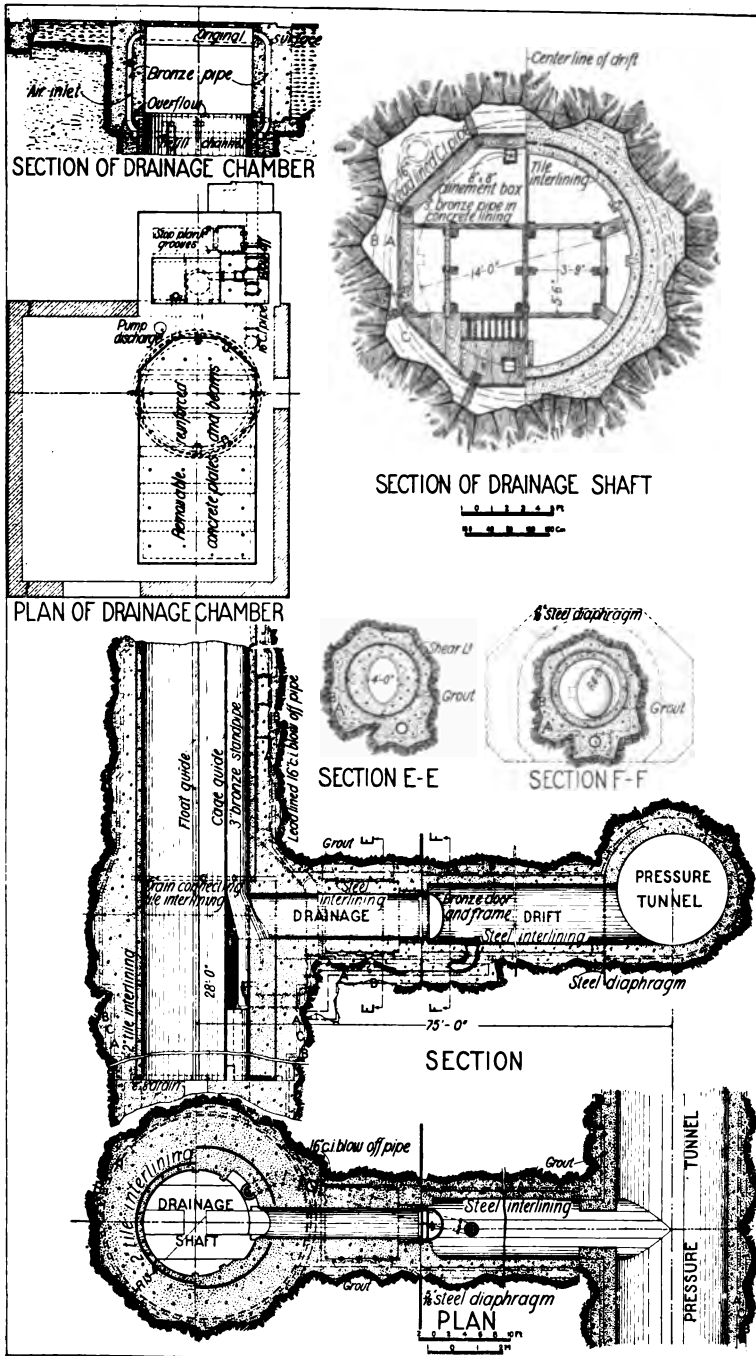
Studies for a filter plant of a capacity sufficient to purify all water brought by Catskill aqueduct were carried far enough to demonstrate that the Eastview site was satisfactory and to determine the limits of the land necessary for construction purposes.

GATE-VALVES AND SLUICE-GATES

Studies for gate-valves and sluice-gates for the Ashokan, Kensico and Hill View gate-chambers were begun and carried on.

EXTENSION OF THE CATSKILL AQUEDUCT

Metal pipes or pressure tunnels in rock are the types available for the aqueduct extension south of Hill View reservoir. These two types were compared as to permanence, economy, interference with street traffic during construction, interference with existing and proposed subsurface structures, especially subways, safety and rapidity of construction. Where the volume of water to be delivered exceeds 150 million gallons daily, pressure tunnels will be advantageous, if geologic conditions are favorable. In Brooklyn, Queens and Richmond the geologic conditions are unfavorable to pressure tunnels, excepting near the Brooklyn East river front, but in these boroughs the volume of water to be carried to any one point is not sufficient to warrant tunnel construction.



CATSKILL AQUEDUCT—Typical pressure tunnel drainage shaft.

As at present proposed, the tunnel will be about 16½ miles long, far below the surface, extending from Hill View reservoir to a point some distance back from the Brooklyn shore of East River. Thence steel and cast-iron pipes will carry portions of the water across Brooklyn to Queens and Richmond, the latter branch including submerged pipes laid under The Narrows.

SUBSURFACE INVESTIGATIONS

Preliminary to the location and design of the extensions of the Catskill aqueduct to the five boroughs, a thorough search was made for data on elevation and character of rock underlying New York City. A study of the rock floor by W. B. Hobbs was available, together with the information on which his deductions were based (Bulletin 270, United States Geological Survey), and rock data were collected from the offices of the Public Service Commission; Department of Docks and Ferries; Department of Bridges; Bureau of Sewers in Manhattan, Brooklyn and The Bronx; Aqueduct Commissioners; Board of Education; New York and Pennsylvania Tunnel Company; New York and Long Island Railroad Company; Manhattan and Hudson River Tunnel Company; New York, New Haven and Hartford Railroad Company; New York Central Railroad Company; Interborough-Metropolitan Railway Company; New York Edison Electric Company, and Consolidated Gas Company. A careful examination of all available rock drill cores was made by Dr. Charles P. Berkey of Columbia University.

TESTS AND EXPERIMENTS

REINFORCED CONCRETE PIPE

The reinforced concrete pipe constructed last year at Hunters brook was tested under various heads up to a maximum of 125 feet, for which the pipe was designed. The principal features of this pipe are: length 210 feet, made up of seven 30-foot sections; inside diameter, 11 feet; thickness, 8 inches; reinforcement, welded rings of twisted square steel bars, about 1 square inch of cross-section for every 2½ inches of pipe length. The concrete, consisting of one part Portland cement, two parts sand or stone screenings and three and one-half parts gravel or broken stone, was machine mixed, quite wet. Transverse tests made on samples of this material at 7 months, the average age of the pipe when tested, indicated an average tensile strength not less than 330 pounds per square inch,

the so-called average transverse strength being 400 pounds per square inch.

When first tested under a head of 28 feet the leakage from the pipe was at the rate of 560,000 gallons per mile per day, most of which was due to porous spots in the sides of the pipe, especially where stone screenings had been used in the concrete instead of natural sand. After grouting and pointing the defective portions with cement mortar, the leakage was as follows:

HEAD FEET		GALLONS PER MILE PER DAY
30	Leakage.....	55,000
62	Initial leakage.....	119,000
	Decreasing after 6 hours to.....	78,000
93	Initial leakage.....	215,000
	Decreasing after 2 days to.....	110,000
125	Initial leakage.....	465,000
	Increasing after 5 repetitions in 6 days to.....	816,000

After again pointing and painting the interior surface with cement grout, the leakage was as follows:

HEAD FEET		GALLONS PER MILE PER DAY
34	Leakage.....	28,000
62	Leakage.....	36,000
92	Leakage.....	114,000
125	Initial leakage.....	240,000
	Increasing after 6 repetitions within 6 days to.....	497,000

The magnitude of the leakage in the first test was due mainly to imperfections in the concrete. Under a moderate head, less than 100 feet, the leakage decreased while the head remained constant, but when the head was increased the leakage increased at a somewhat higher ratio. On reaching a certain "critical head," in this case about 100 feet, the permeability of the pipe was radically changed, the leakage not only increasing at a much higher ratio than the head, but with each new application of pressure, indicating that the concrete begins to crack when the "critical head" is exceeded. A large number of longitudinal cracks were actually observed; most of them, however, were so fine as to be perceptible only by color differences while the concrete was still damp after the pipe was emptied. When the first cracks appeared the tensile stress in the concrete was estimated at 270 pounds per square inch, or 82 per cent. of that derived from the beam tests. The above results are for the pipe as a whole, although considerable portions of the pipe remained dust-dry under the maximum head of 125 feet.

CORROSION OF STEEL PIPE

In an endeavor to ascertain the causes of corrosion of large steel pipes and to devise preventives, the pipes that carry the water-supply of Rochester, N. Y., were studied in the field by members of Headquarters department staff. Data relating to several other pipe-lines were also collected and studied and experiments conducted with numerous preservative coatings for steel and iron.

EXPERIMENTS ON MORTAR LININGS FOR STEEL PIPE

The most important investigation that was made during the year was in relation to the use of mortar lining for steel pipes. Plastering with cement mortar directly on the interior of the pipe and on metal lath, tile and concrete blocks laid in cement mortar and plastered with cement mortar, and grouting around a form were tried and were successful with the exception of plastering on metal lath, in which case the mortar could not be satisfactorily forced through the lath so as to thoroughly embed it and make close contact with the steel pipe.

AERATION

To determine the type of nozzle best suited to aerating water under heads from 20 to 25 feet, approximating conditions at Kensico reservoir, experimental nozzles were made and tested, the aim being to select a nozzle which would at the same time:

1. Thoroughly divide the water into small drops, and so distribute it as to give the greatest exposure to the air.
2. Discharge the water with sufficient force to cause the liberation of included gases, such as carbon dioxide.
3. Present an unobstructed waterway of reasonably large diameter.

Results clearly showed that a rotary motion in the jet, produced by curved vanes projecting into the waterway of a short pipe placed just below a plain conical or a flaring nozzle, increased the aerating efficiency through better distribution. These vanes caused a whirling motion easily discernable in the issuing jets, and resulted in an immediate and thorough division of the jets into small particles which were projected upward so as to form well defined inverted cones. In a wind these jets were steadier and their form more resistant than those from nozzles without vanes. Distribution of water by these jets was also more uniform than that obtained from any form of nozzle without vanes. Two impinging jets issuing



**CATSKILL AQUEDUCT—Experiments on Mortar Lining of Steel Pipes. Angle Iron
Ribs and Metal Lath being placed to receive Plaster.**



CATSKILL AQUEDUCT—Experiments on 'Mortar Lining of Steel Pipes.' Back of a Section of Lining plastered on to Metal Lath and Angle Iron Ribs in Top of Pipe.

from plain conical nozzles arranged at angles between 45 and 90 degrees with each other, either with or without vanes, and the jet from an open end pipe with vanes, were also tried, but while apparently good aerators, were extravagant of space. Sewage sprinklers were inferior to other nozzles. All nozzles were $1\frac{1}{4}$ inches in diameter.

By the courtesy of the Department of Water Supply, Gas and Electricity, these tests were conducted at the Coney Island repair shop, between November 14 and December 1, water for the tests being delivered from a City hydrant through a hose to a 4-inch manifold containing vertical outlets which could be capped or fitted with the nozzles as desired.

CONTRACT CEMENT

All Portland cement used in construction was inspected and tested. As the cement passed from the grinding mill into the storage bins, samples were taken for every 300 barrels and forwarded to the laboratory for testing, in accordance with the contract specifications. Cement which met the requirements was packed and loaded, as needed, under the supervision of the Board's inspector, and shipped under the Board's seal. Following is a record of the tests:

RECORD OF CEMENT TESTS

Barrels tested.....	162,793
Per cent. accepted.....	68
Per cent. rejected—low strength.....	23
Per cent. rejected—lack of increase in strength between 7 and 28 days.....	5
Per cent. rejected—excess of anhydrous sulphuric acid.....	3
Per cent. rejected—unsoundness.....	1
Per cent. rejected—all causes.....	32

CONCRETE MATERIALS

One hundred and thirty-nine tests were made of concrete aggregate from localities along the line of the Catskill aqueduct, including strength tests of mortar and concrete, to determine the suitability of the materials for construction.

PERMEABILITY OF CONCRETE

Further studies were made of the permeability of concrete, but no final conclusions were reached. Concrete, as regards permeability, is subject to accidental variations in a much greater degree than as regards strength, yet a study of the former property reveals certain governing laws. The quality of cement used is an important element. Concrete of properly graded natural aggregates, con-

taining over 15 per cent. of cement by weight, was found by the experiments to be practically impermeable under heads less than 200 feet. As the percentage of cement was reduced, the permeability increased slowly until about 11 per cent. was reached, when the permeability increased very rapidly. Proper grading of the aggregates is another important condition. High percentages of fine particles produce a decided reduction in permeability, while tests with natural sand, of which 25 per cent. was finer than 0.01 inch and 10 per cent. finer than 0.006 inch in diameter in a 1 : 3 mortar, resulted in practical impermeability. When made from broken stone and screenings, concrete is more permeable than when made from gravel and natural sand. Concrete is more permeable in a direction parallel to its bed than perpendicular thereto.

The dense skin formed on the surface of concrete was found to have a very important effect on permeability. Leakage through specimens 6 inches thick, from which the surface skin had been removed, being much greater than through specimens otherwise similar, whose surface was undisturbed.

FILTER SANDS

The quality and cost of filter sands for use in Eastview filters were studied. Investigation included materials near the filter site, those available in the New York market and from several undeveloped deposits on Long Island and in New Jersey.

HUDSON RIVER WATER

The quality of Hudson river water at Storm King was studied to determine its suitability as an emergency supply. Analyses were made of samples taken each day at different stages of the tide over a period of 8 months. During April, May and June the chlorine present was generally less than 5 parts per million; in July a rapid increase commenced, the chlorine exceeding 100 parts per million by the middle of the month, increasing to 900 parts per million in August, 2,500 parts per million in September, and continuing generally above 2,000 parts per million throughout October and November. In the early part of December it fell off to 1,500 parts per million. Manifestly, for a continuous period of 5 months, the water at this point contained sufficient chlorine to preclude its use as a domestic supply.

A few observations made at Newburg and Poughkeepsie also gave high chlorine contents, while in samples taken near Kingston the chlorine was negligible.



CATSKILL AQUEDUCT—Experiments on Mortar Lining of Steel Pipes. Nos. 3 and 6 are pieces of Reinforced Grout Lining; others are Terra-Cotta Tile and Concrete Blocks built into Plaster Lining.

REAL ESTATE

The principal activities of the Real Estate division during 1908 consisted in preparing maps for approval by the Board of Water Supply; drawing up technical descriptions of real estate sections for use in advertising notices of The City's intention to apply to the Supreme Court for appointment of commissioners of appraisal; drawing up technical descriptions of each separate parcel contained in these sections, for use in petitioning the Supreme Court for appointment of commissioners of appraisal; preparing special data for appraisal commissions; preparing applications to National and State governments and private corporations for permits.

Maps were completed covering all the real estate necessary for the construction of the Catskill aqueduct between Ashokan and Kensico reservoirs, for the construction of the Kensico and Hill View reservoirs, and for the construction of the Ashokan reservoir excepting four sections in the course of preparation to be numbered 15, 16, 17, and 18. A detailed statement of the real estate maps and acquisitions is given in Tables 12 and 13.

CONTRACTS AND AGREEMENTS

Amounts expended on all completed contracts and agreements and estimated total amounts to be expended on uncompleted contracts and agreements are as follows:

AMOUNTS OF CONTRACTS AND AGREEMENTS

YEAR	STRUCTURE	CONTRACTS	AGREEMENTS
1905	Catskill aqueduct.....		\$29,291.57
	Total.....		\$29,291.57
1906	Ashokan reservoir.....		\$53,959.78
	Kensico reservoir.....		6,300.00
	Catskill aqueduct.....	\$170,000.00	139,141.77
	Suffolk county sources.....		5,537.94
	Totals.....	\$170,000.00	\$204,939.49
1907	Ashokan reservoir.....	\$12,683,428.22	\$25,000.00
	Kensico reservoir.....		4,288.46
	All territory north of Hill View reservoir		101,174.67
	Catskill aqueduct.....	4,137,518.00	618,957.58
	Kensico reservoir and Catskill aqueduct		19,874.38
	Catskill aqueduct extension.....		4,997.63
	Suffolk county sources.....		8,633.70
	Totals.....	\$16,820,946.22	\$782,906.42
1908	Catskill aqueduct.....	9,627,556.00	62,971.00
	Catskill aqueduct extension.....	105,678.00	
	General purposes.....	12,893.35	
	Totals.....	\$9,746,127.35	\$62,971.00
	Grand Totals.....	\$26,737,073.57	\$1,080,108.48

Details of the above arranged by structures form Tables 1 and 2, and the canvasses of bids on all contracts advertised during the year are given in Tables 3 to 11, inclusive.

PREPARATION OF CONTRACTS DURING 1908

	PREPARED BY		TOTALS
	Headquarters	Field Departments	
Estimated cost of contracts prepared and printed.....	\$16,640,000.00	\$8,200,000.00	\$24,840,000.00
Estimated cost of contracts partly prepared.....	14,550,000.00	.....	14,550,000.00
Totals.....	\$31,190,000.00	\$8,200,000.00	\$39,390,000.00
Length of aqueduct for which contracts have been prepared, and printed..	23.8 miles	18.2 miles	42.0 miles
Length of aqueduct for which contracts have been partially prepared....	4.8 miles	.....	4.8 miles
Totals.....	28.6 miles	18.2 miles	46.8 miles

Contract 1 with The Phoenix Construction Company, New York City, for test-borings in channel and along shores of Hudson river at or near New Hamburg was modified in 1907 to locate operations at or near Storm King. February 21, 1908, American Diamond Rock Drill Company assigned the contract to The Phoenix Construction Company and June 11 the contract was further modified to provide for boring a third special vertical hole to a depth of 1,000 feet, if practicable.

Contract 14, for the Wallkill siphon, was advertised April 18, 1908. Bids were opened May 12, but were rejected May 27. This work was divided into Contracts 36 and 37 for the north and south halves of siphon respectively and advertised commencing December 18, 1908, bids to be opened January 7, 1909.

Contract 40, for three field office buildings, three horse-sheds and one stable in the Towns of Olive and Marletown, Ulster county, was advertised December 17, 1908. Bids are to be opened January 5, 1909.

Contracts awarded during the year:

6, 11, 12, 15, 38, A, B and modification of 1.

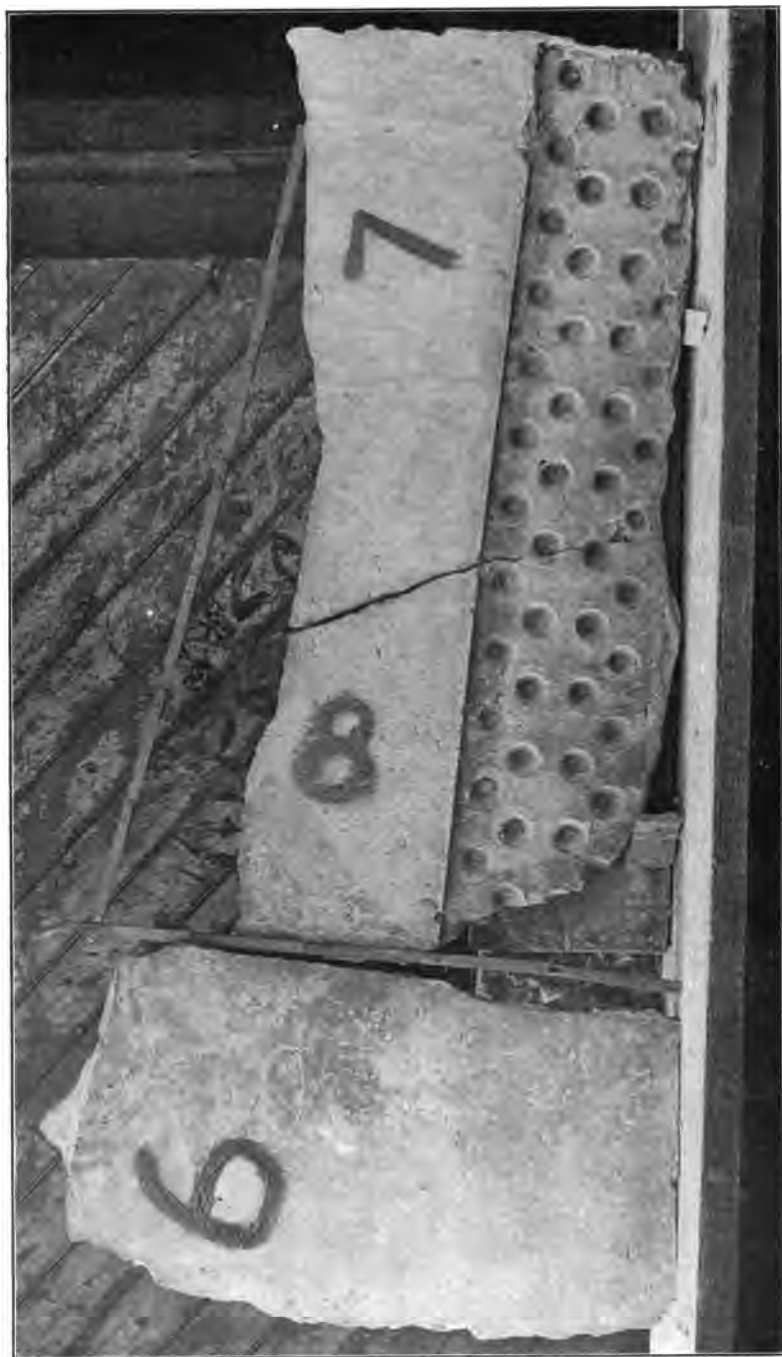
Contracts advertised but not awarded:

14 Wallkill siphon.

36 North half Wallkill siphon.

37 South half Wallkill siphon.

40 Field office building.



CATSKILL AQUEDUCT—Experiments on Mortar Lining of Steel Pipes. Back of pieces of G-out Lining removed from pipe.



CATSKILL AQUEDUCT—Experiments on Mortar Lining of Steel Pipes. Back of a Section of Lining plastered on to Metal Lath and Angle Iron Ribs in Bottom of Pipe.

RESERVOIR DEPARTMENT

CARLETON E. DAVIS, *Department Engineer*

Work in the Reservoir department during 1908 was largely concentrated on the Ashokan reservoir and connected features of the Esopus watershed. Hydrographic work in all the Catskill mountain watersheds was continued, and also subsurface investigations at the dam sites on the Rondout creek.

ORGANIZATION

DIVISIONS AND EMPLOYEES

The organization put into effect during the latter part of 1907 was continued throughout 1908 and developed to meet the demands of increasing construction under Contract 3, for the main dams of the Ashokan reservoir. In general the lines of the divisions are defined by field-work and office work, rather than geographically.

EXECUTIVE DIVISION

J. S. Langthorn, Division Engineer, Brown's Station, N. Y. This division, besides handling the executive work of the department, had charge of hydrographic work, preliminary plans and studies throughout the department, except for real estate and highways, and all office work in connection with the execution of Contract 3. In its executive functions, this division practically constituted the department office, the Division Engineer serving as Acting Department Engineer as occasion demanded.

OLIVE BRIDGE DIVISION

H. S. R. McCurdy, Acting Division Engineer, Brown's Station. This division had charge of all supervision, inspection and field-work in connection with Contract 3, for the main dams of the Ashokan reservoir.

REAL ESTATE DIVISION

Fred K. Betts, Division Engineer, 293 Wall street, Kingston. This division was in charge of real estate, highways and bridges, and the Kingston sewer.

FORCE IN RESERVOIR DEPARTMENT—1908

	MONTHLY PAYROLL	WEEKLY PAYROLL	GAGE KEEPERS
Jan. 1, 1908.....	86	26	39
Dec. 31, 1908.....	83	35	37
Maximum.....	88	41	39
Minimum.....	77	24	37

OFFICES

As far as practicable, buildings acquired in the condemnation of land for the Ashokan reservoir are utilized as offices. The real estate office at Kingston and a field office at West Hurley were the only ones under lease at the end of the year. The field office at West Shokan was given up at the end of March, and the office at Prattsville at the end of May.

The department work centers at Brown's Station, where the Department Engineer and the Executive division occupy a building which was formerly a hotel. The necessary changes in this building, including the construction of a fire-proof vault, were completed early in the year. The office of the Hydrographic section was moved in March from West Shokan to a house at Brown's Station, which came into the possession of The City in that month.

The engineer in charge of the Olive Bridge division has office room in the department building at Brown's Station. The construction section at the dam has its office in a suitable building near the work. The office of the Real Estate division was continued at 293 Wall street, Kingston. The field office at West Hurley was used in common by the Real Estate division and the various sections of the Executive division.

The branch exchange of the telephone system connecting the offices of the department was moved from West Shokan to the department office at Brown's Station.

SUMMARY OF YEAR'S WORK

Work on Contract 3, for the main dams of the Ashokan reservoir, was in progress throughout 1908. The efforts of the contractor were concentrated principally on the installation of plant and on the foundations of the Olive Bridge dam in Esopus creek. The excavation in the creek bed was so far advanced that the masonry



ASHOKAN RESERVOIR—Contract 3, Olive Bridge Dam, July 15, 1908. Excavation for Masonry Portion. Steel Pipes, carrying summer flow of Esopus, between coffer dams.

of the dam was started in September. At the end of the year the gorge of the Esopus was closed with masonry to a height of 15 feet above the bed of the stream, and the stream was turned into the opening provided for it through the dam. Work on the dikes and on the earth wings of the dam was confined to clearing and stripping several hundred linear feet of core-wall, several thousand cubic yards of embankment, the conduit for the control of the Beaver Kill, and the Hog Vly diversion channel. At the end of the year about 7 per cent. of the total contract, as measured by the monthly estimates, was completed. Progress is shown graphically on accompanying photographs.

Studies and plans were made of various details incident to the construction of the main dams, and diamond drill borings were put down to furnish additional underground information. Construction of the first section of Kingston sewer, Contract 5, was completed in June, and plans and specifications for placing the remainder under contract were finished. Preliminary studies and designs for the West Hurley dikes were continued and diamond drill borings and test-pits were put down to develop material for construction and furnish information for bidders. Surveys of the land required for Ashokan reservoir were finished, and maps for use in condemnation proceedings were completed. Highway surveys were continued and plans and specifications well advanced. Meteorological observations and measurements of stream flow were taken in all the Catskill watersheds and some adjacent territory. Diamond drill borings at reservoir sites on the Rondout were continued, and studies for the development of that supply were made.

PRELIMINARY WORK

SURVEYS

Few general surveys were made, since complete topographic maps of the Ashokan basin made during previous years furnished practically all data that the developments of the year required. A small amount of field-work was done to furnish some detail information for the location of the Hurley dikes, the Catskill aqueduct from the Headworks to Esopus creek, and for the relocation of the Ulster and Delaware Railroad. Surveys for new highways were continued and 18 miles were located, making a total of 38 miles to date.

SUBSURFACE INVESTIGATIONS

Diamond drill borings and hydraulic pressure tests to determine the character and condition of rock in the Esopus gorge underlying the Olive Bridge dam were completed in February. Ten holes were put down and tested under pressure at each foot of depth. All told, nineteen borings were made in this investigation with a total depth of 1,292 feet, the explorations reaching to a depth of 100 feet below the bed of the stream in the gorge and covering the adjacent rock sides. The borings indicated that the rock consists of nearly horizontal layers of alternating beds of bluestone, black slate and green shale, with no cavities. The pressure tests disclosed numerous small seams near the surface of the rock and two other general seams at depths of 40 feet and 60 feet below the bed of the creek. These two seams extended in the rock for the full width of the dam up and down stream, but did not reach far beyond the sides of the gorge. Beneath the lower of these seams the tests showed the rock to be entirely free from any such features. Rock excavation for the dam developed all the seams indicated by these tests, but did not disclose any additional ones nor any characteristics in the rock not anticipated by the experiments.

At the close of the year two boring outfits were engaged in drilling on the site of the West channel of the main dams to determine the extent of an area of quicksand which was encountered in the excavation of the Hog Vly diversion, and which apparently extends into the confines of the channel.

Investigations to locate borrow-pits for the construction of the Hurley dikes were carried on at such times as the boring rigs could be spared from other work, and a few holes were put down to ascertain the characteristics of the rock on the lines of these dikes. Fourteen diamond drill borings were made and 35 test-pits dug in this work.

Borings in the Rondout watershed for the proposed Lackawack reservoir, begun in 1907 by Sprague and Henwood under Agreement 44, were discontinued in April. Eight holes, aggregating 1,339 feet in earth and rock, were put down, making a total of 12 holes with an aggregate depth of 1,940 feet for the work on the Rondout under Agreement 44.

HYDROGRAPHIC WORK

The territory covered by rainfall and stream flow observations remained as in 1907, the same stations being maintained except the gaging point on the Catskill creek, which was moved several

miles upstream from South Cairo to East Durham. This change was made on account of irregularity of flow caused by storage in the stream between the two points.

The automatic records of flow over the concrete weir in the Esopus were interrupted from May 1 to August 3, when the water in the creek was kept below the crest of the weir in order to facilitate work on the foundations of the Olive Bridge dam. During this period a continuous record of the height of the stream was kept by an automatic register at the gaging station above Bishop's Falls. The automatic records of flow of the Rondout at the dam of the Honk Falls Power Company were continued without interruption.

Current meter measurements were made at all gaging stations, and the rating curves modified to suit new conditions. Measurements were taken at favorable points on the streams as a check on the regular stations. Careful supervision was given to the work of local observers who took stream heights twice daily. The meter measurements are tabulated below.

STREAM FLOW MEASUREMENTS—1908

STATION	STREAM	NUMBER OF MEASUREMENTS BY CURRENT METER	RANGE OF STREAM FLOW IN CUBIC FEET PER SECOND	
			Maximum	Minimum
Olive Bridge.....	Esopus.....	74	10,517	18.5
Kingston.....	Esopus.....	58	8,833	24.0
Mt. Marion.....	Esopus.....	27	6,900	30.0
	Beaver Kill.....	19	68	0.14
Rosendale.....	Rondout.....	32	5,213	19.0
Allgerville.....	Rondout.....	24	6,588	50.0
Napanoch.....	Rondout.....	13	380	6.3
Lackawack.....	Rondout.....	18	1,699	16.0
	Vernooey creek.....	18	510	0.7
Sloansville.....	Schoharie.....	4	943	19.0
Esperance.....	Schoharie.....	18	7,273	13.0
Schoharie Junction.....	Schoharie.....	6	929	25.0
Middleburg.....	Schoharie.....	15	4,200	12.0
Prattsville.....	Schoharie.....	25	2,085	7.0
	Cobleskill creek ..	6	288	0.74
	Fox Creek.....	6	312	2.9
South Cairo.....	Catskill.....	12	1,145	5.0
East Durham.....	Catskill.....	19	246	0.7
Hamburg.....	Catskill.....	7	266	3.1
	Sunnyside creek ...	6	66	0.34

In addition, 367 meter measurements were made at 24 stations on small streams within the area taken for the Ashokan reservoir, and the information obtained was used in testimony given in condemnation proceedings.

The maximum recorded discharge of the Esopus creek occurred February 15, when for a short time the run-off was at the

rate of 15,800 cubic feet per second from the 239 square miles tributary to the weir. The minimum flow observed was 18 cubic feet per second in September. Rainfall and run-off from the area tributary to the Ashokan reservoir for 1908 is as follows: Area of watershed, including Mink Hollow, 257 square miles; rainfall (average of 12 stations), 45.50 inches; run-off, 28.41 inches; run-off, 127 billion gallons; percentage of rainfall appearing as stream flow, 62; equivalent yield, 1.4 million gallons per day per square mile.

Rainfall and principal stream flow records are given in Tables 17, 18 and 19.

STUDIES AND DESIGNS

MAIN DAMS, ASHOKAN RESERVOIR

The method of controlling the flow of the Beaver Kill was developed and adopted. This plan of control consists of a masonry conduit founded on rock for its entire length under the dike except for about 50 feet near the down-stream toe. The conduit is 607 feet long, 9 feet high and 14 feet wide, provision being made for bulkheads so that it can be entirely filled with concrete at some future date.

Studies to determine the most economical locations for the West channel and the Discharge channel resulted in their positions being definitely fixed.

Detail drawings were prepared for the drainage system under the down-stream embankments of the dam and dikes and for the excavation for the arched core-wall in the Beaver Kill gorge.

HURLEY DIKES

The location of the dikes at the eastern end of the Ashokan reservoir was decided upon in February. Three dikes, the West Hurley, the Woodstock and the Glenford, will be required to close depressions in the ridges forming the margin of the basin in the vicinity of West Hurley, the total length of the necessary structures being about 1.6 miles. The relocated Ulster and Delaware Railroad will cross Glenford valley on the dike of that name.

RELOCATION OF THE ULSTER AND DELAWARE RAILROAD

Preliminary studies, plans and estimates were concluded.



ASHOKAN RESERVOIR—Contract 3, Olive Bridge Dam, September 11, 1908. Bottom of excavation for Masonry Portion, cut-off trench in middle background.

KINGSTON SEWER

Plans and specifications were prepared for the completion of the Kingston trunk sewer. The new work will consist of 6,200 feet of sewer in tunnel and 1,300 feet in open-cut excavation.

NEW HIGHWAYS

Studies and plans are in progress for new highways with necessary bridges and culverts. Thirty-one detail plans covering 20 miles were completed.

REAL ESTATE**SURVEYS AND MAPS**

Surveys and maps of the land required for the Ashokan reservoir were finished. The area covered by the surveys is 22,693 acres, of which 15,254 acres, consisting of 954 parcels, are within the taking line and are shown on the detail maps. For purposes of condemnation the lands were divided into 18 sections of about 50 parcels each; each section was mapped on a number of sheets, 209 in all being required. During the year 80 maps showing properties condemned only in part, and 9 supplementary maps were made for use before the commissions of appraisal. Maps for use in the proceedings for the change of highways at Ashokan reservoir were completed. These maps consist of 20 sheets and show existing highways which are to be discontinued with plans and profiles of the substituted new highways.

Investigations of cemeteries were continued, revealing within the taking lines 2,813 known interments to date. All available data concerning each grave were tabulated, as well as information in regard to several hundred separate cemetery lots for which distinct titles in fee were found.

The survey of Esopus creek between Ashokan reservoir and the Hudson river was completed. The total length of creek covered was 30 miles. Surveys and plans of properties bordering on this portion of the creek are in progress.

CONSTRUCTION**MAIN DAMS OF ASHOKAN RESERVOIR**

Contract 3, MacArthur Brothers Company and Winston & Company, Contractors.

At the beginning of the year work under this contract was in progress on camps, railroads and plant. During the year camps

for about 1,600 men, besides women and children, were built and provided with the sanitary necessities called for in the contract; a plant for effectively prosecuting the work on the dam was erected, and progress was made toward installing plant for work at various points on the dikes; the masonry dam in the gorge of the Esopus creek was advanced to a height beyond that of ordinary spring flows of the stream; the Beaver Kill was diverted and the excavation in the pre-glacial gorge beneath the old channel was about half completed; the sites of all dikes were generally cleared and stripped; and quarries and sand-pits were opened and railroads connecting them with the dam were built. Cableways are used for building the masonry section of the dam and excavating material for its foundations. The plant installed consists of 4 Lidgerwood traveling cableways, having a clear span of 1,530 feet and a lifting capacity of 15 tons each. The tracks for the towers permit the cables to be moved so as to cover a total distance of 600 feet up and down stream, sufficient to allow material to be delivered at any point of the construction. The towers are 93 feet high, and as the tracks are placed 150 feet above the bed of the creek, the present position of the cableways can be maintained till the dam is about 125 feet high in the center. The first cableway was put in use June 28, and the fourth on August 1.

Cableway engines, and the general plant of hoisting engines, drills, channelers and pumps, in use at the dam are operated by compressed air, furnished from a central power station located on the north bank of the Esopus up stream from the dam. This power plant consists of 4 Ingersoll-Rand cross-compound air-compressors of a total rated capacity of 12,000 cubic feet of air per minute, considered the equivalent of 1,600 horse-power, and 5 Babcock and Wilcox boilers rated at 265 horse-power each. This central power station furnishes in addition air for the drills and engines at the quarry and for part of the plant on the dikes.

The plant for crushing stone and mixing concrete is located near the power station. The crushing outfit consists of one Number 9 McCully crusher and two Number 6 Austin crushers, the latter re-crushing the large stone that passes the former. Accepted stone passes through 2¼-inch rings in a revolving screen and is elevated to a storage bin of 1,200 cubic yards capacity over the mixers. Screenings passing on a ¼-inch wire mesh are carried to the sand-pits and from thence elevated with the bank sand to a storage bin adjacent to the stone bin. A cement storehouse of 4,000 barrels capacity adjoins the mixing plant and is connected with the mixing

floor by a conveyor so arranged that cement can be delivered directly from the cars or taken from stock. Belt conveyors transport crushed stone and sand from all parts of the bins to the measuring hoppers. Four cubical mixers of $2\frac{1}{2}$ cubic yards capacity each are installed. Directly under them are tracks leading to the cableways and the blockyard. The entire plant is driven by a 275 horsepower steam engine, supplied with steam from the boilers of the central power station.

The coffer-dams and two 8-foot steel pipes built by the Board for carrying the summer flow of the Esopus over the site of the dam were being operated by the contractor at the beginning of the year. Frequent heavy rains in the spring kept the creek higher than the capacity of the control pipes till the first of June. On the subsidence of the water early in that month the control works being in place permitted excavation in the bed of the creek to proceed at once.

Covering most of the rock in the bed of the creek were several feet of gravel and boulders which were disposed of in the channel of the stream below the lower coffer-dam. Excavation in rock under the main body of the dam was carried 29 feet below the bed of the creek at the deepest point, while along the up-stream toe of the dam a cut-off channel about 20 feet wide was excavated to a depth of 40 feet. This cut-off channel was carried into the side walls of the gorge, the bottom being stepped up when the character of the rock warranted such a procedure. Rock on the sides of the gorge was removed, on the north side little more than the overhang being taken off, while on the south side two or three feet additional were excavated. The rock in the bed of the stream was massive blue stone at the surface, overlying alternating layers of slate, shale and thin beds of blue stone. In the course of its geologic history the shale was heavily loaded with superimposed strata. Following its unloading through a long period of erosion, and the comparatively recent cutting of the Esopus gorge, the shale expanded and seams developed along the bedding planes. The limits of rock excavation were determined by the extent of these seams, and as they decreased in number with the depth, and became tight as they ran from the center of the gorge to the sides, the excavation took the general form of a series of steps, with the greatest depth along the center of the stream bed.

The cut-off trench intercepts all seams to a depth of 40 feet below the bed of the stream. As a still further precaution, a row of 3-inch grouting holes was drilled 20 feet below the bottom of that

trench, reaching the greatest depth at which the pressure tests had indicated the presence of seams. Similar grouting holes were drilled to about the depth of the cut-off to insure the sealing of any seams that might exist in the rock under the main body of the dam. All told 255 holes were drilled, aggregating 2,707 feet. Two-inch iron pipes were cemented into the tops of the drill holes and carried up into the masonry to permit grouting when the dam had reached sufficient height.

In general, the lines along the edge of the rock excavation for the dam were cut with Sullivan channeling machines. When the rock was freed in this manner from the ledge light charges of powder were used to break it up. When channeling was not practicable careful shooting with black powder was permitted, the final excavation being always done by barring and wedging. The rock excavation was so far advanced that laying masonry in the main body of the dam was begun on September 23, and in the cut-off on October 15. The invert of the opening, or conduit, in the dam through which the Esopus will flow during construction is at Elevation 403. This height was reached October 21, and a month later the side walls of the conduit were completed to Elevation 415, the limit set for the season of 1908. The stream was diverted through this opening and the 8-foot steel control pipes were entirely removed by December 5. Work was shut down for the winter on December 29. At that time the general level of the masonry in the creek bottom was about 15 feet above the bed of the stream, the principal exception being at the south end of the cut-off, where the rock excavation into the wall of the gorge was not completed.

The grouting holes in the bottom of the cut-off trench were grouted, treatment of those in the rest of the dam being postponed. A Cockburn-Barrow grout machine of 4 cubic feet capacity, operated by air under a pressure ranging from 25 to 80 pounds, was used. The grout was neat cement mixed in proportions of one part by volume of cement to one part by volume of water. Thirty-one holes were grouted, and approximately 74 cubic feet of grout, over and above the volume of the holes, were forced in.

Before the 8-foot control pipes were removed, the stream bed between the masonry and the up-stream coffer-dam was cleared of all earth and stone to bed-rock, and all loose scales removed from the rock itself, in anticipation of the eventual filling of this space with fine earth. The 8-foot pipes were sufficient to pass all stream flow from the first of June till after their removal, with the excep-



ASHOKAN RESERVOIR—Contract 3, Olive Bridge Dam, October 15, 1908. Cut-off Trench looking South from North Side of Gorge.



tion of a few hours on the night of October 26. The delay to the work from this high water lasted 2 days. As a rule, work on both rock excavation and masonry was carried on day and night during the season. In addition to the work in the gorge, earth and rock excavation for the foundations of the dam was in progress on both banks, the material thus removed being placed in the earth embankment cones that flank the masonry section.

The monthly progress on the masonry section of the dam and data of interest in connection with the construction are given in the following table:

OLIVE BRIDGE DAM, MASONRY SECTION—MONTHLY PROGRESS, 1908

	EARTH EXCAVATION	ROCK EXCAVATION	PORTLAND CEMENT	MASONRY	CONCRETE BLOCKS
	Cubic Yards	Cubic Yards	Barrels	Cubic Yards	Cubic Yards
Previous to May 20..	2,752	723	.....	.....	.....
May 20 to Jun. 20..	3,948	2,982	.....	.....	.....
Jun. 20 to Jul. 20..	5,156	5,441	.....	.....	.....
Jul. 20 to Aug. 20..	6,900	10,732	.....	.....	.....
Aug. 20 to Sep. 20..	11,244	11,282	.....	.....	.....
Sep. 20 to Oct. 20..	14,200	7,040	7,700	7,000	.....
Oct. 20 to Nov. 20..	14,500	2,836	20,600	13,500	163
Nov. 20 to Dec. 20..	1,800	563	6,816	4,885	37
Totals	60,500	41,399	35,116	25,385	200

The maximum weekly progress on the masonry was made during the week ending November 11, when about 5,400 cubic yards of cyclopean masonry were placed.

PRINCIPAL FEATURES OF OLIVE BRIDGE DAM

MASONRY SECTION	FEET
Length of masonry section.....	1,000
Elevation of top of dam.....	610
Average elevation of original creek bed.....	400
Elevation of lowest point in cut-off trench.....	358
Elevation of lowest point in excavation for main dam, outside of cut-off trench.....	371
Elevation of lowest point reached by grout holes.....	338
Maximum width of base of masonry dam.....	200

OLIVE BRIDGE DAM—NORTH AND SOUTH WINGS

Work on the earth wings of the dam was confined chiefly to the preparation of the sites and the disposal of the material excavated from the masonry section. The areas were grubbed and stripped,

earth embankment placed under the cable tower tracks, drains laid beneath the down-stream toes, earth and stone deposited in the embankments for the cones, and a short length of core-wall built in trench excavated to rock on the south wing.

The progress was as follows:

OLIVE BRIDGE DAM EARTH EMBANKMENTS—MONTHLY PROGRESS,
1908

	EARTH EX- CAVATION	ROCK EX- CAVATION	EMBANK- MENT	PORTLAND CEMENT	CONCRETE	VITRIFIED PIPE LAID
	Cubic Yards	Cubic Yards	Cubic Yards	Barrels	Cubic Yards	Feet
Previous to May 20..	13,122	41	8,360	22	13	1,428
May 20 to Jun. 20..	9,935		18,084	5	3	297
Jun. 20 to Jul. 20..	10,767	102	15,359	43	25	1,382
Jul. 20 to Aug. 20..	6,081	2	20,932	22	18	257
Aug. 20 to Sep. 20..	1,485	94	29,605	235	57	540
Sep. 20 to Oct. 20..	5,982	16	23,940	159	108	.....
Oct. 20 to Nov. 20..	1,040	8	18,000	400	222	.....
Nov. 20 to Dec. 20..	1,430	5	8,000	600	522	.....
Totals.....	49,822	268	142,280	1,486	968	3,904

BEAVER KILL DIKES

The sites of the embankments were cleared, grubbed and stripped, except a small area on Lawson hill. Drains were laid beneath the down-stream toes of embankments, earth fill was placed in low spots and for cable tower foundations, and short sections of core-wall were built up to the surface of the ground. Work on earth embankments and on core-walls ceased December 6 and 15 respectively.

Excavation for the diversion of the Beaver Kill was started in May. In August the conduit masonry had advanced to a stage permitting the stream to be diverted and excavation began for the arched core-wall in the pre-glacial gorge of the Beaver Kill. The material excavated from the gorge was handled by two Page excavators. At the end of the year the excavation reached a depth about 40 feet below the stream bed, about 60 per cent. of the material having been removed. A channel 4,300 feet in length was excavated to divert the water of the Hog Vly Kill from the site of the West dike and the West inlet channel.

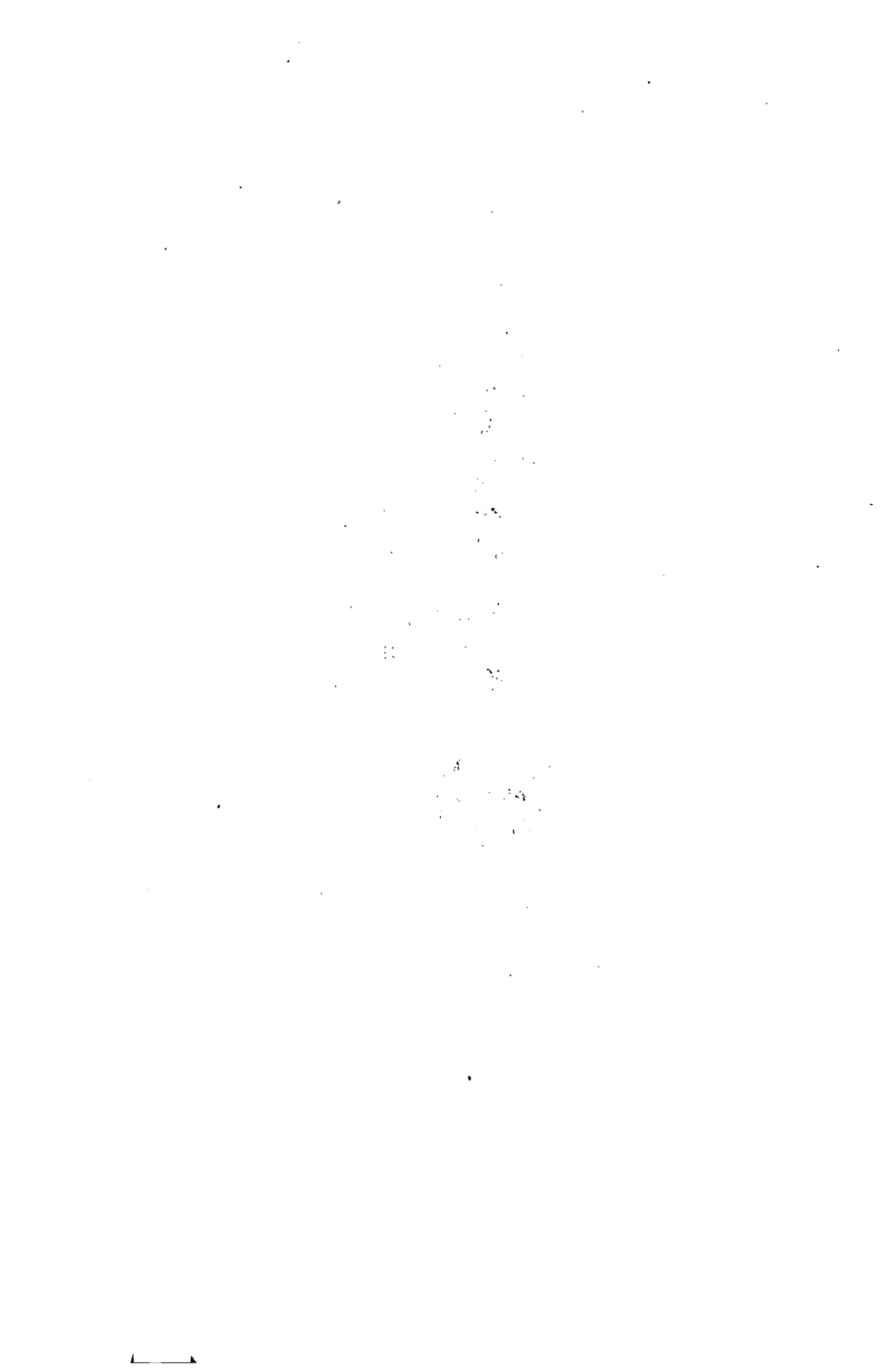
The progress of construction on the Beaver Kill dikes and connected structures was as follows:



ASHOKAN RESERVOIR—Contract 3, Olive Bridge Dam, December 5, 1908. View of dam, looking up stream, just after removal of stream control pipes.
Stream flowing through temporary conduit in dam.



ASHOKAN RESERVOIR—Contract 3, East Dike, August 18, 1908. General view, looking West from Waste-Weir. Showing Stripping, Core-Wall Excavation and Class C Embankment at Sides.



BEAVER KILL DIKES—MONTHLY PROGRESS, 1908.

	EARTH EX- CAVATION	ROCK EX- CAVATION	EMBANK- MENT	PORTLAND CEMENT	CONCRETE	VITRIFIED PIPE LAID
	Cubic Yards	Cubic Yards	Cubic Yards	Barrels	Cubic Yards	Feet
Previous to May 20..	6,973	186	3,855			
May 20 to Jun. 20..	18,530	475	8,150	3	2	682
Jun. 20 to Jul. 20..	41,493	1,634	14,501	23	13	841
Jul. 20 to Aug. 20..	48,106	728	19,379	1,726	1,094	1,692
Aug. 20 to Sep. 20..	43,449	978	31,887	2,618	1,183	545
Sep. 20 to Oct. 20..	30,533	370	20,252	5,560	4,266	2,509
Oct. 20 to Nov. 20..	31,739	364	22,130	8,173	5,644	1,131
Nov. 20 to Dec. 20..	24,533	386	24,300	2,561	2,680	.....
Totals.....	243,355	5,091	144,454	20,664	14,882	7,400

CONTRACTOR'S CAMPS

The main camp for Contract 3 is situated outside of the reservoir on the southerly slope of Winchell hill near the dam. It comprises about 150 dwellings, office buildings, a commissary, bakery, store-houses, barns, a school house, and a hospital for emergency cases. The camp is provided with a sewerage system and a sewage disposal plant, the effluent being discharged into the Esopus below the dam site. Water for domestic purposes is obtained by pumping from springs and that for fire protection and construction from the Esopus by pumping to a reservoir of 200,000 gallons capacity located on the top of Winchell hill.

Smaller camps were established outside the drainage area to provide accommodations for men employed on the South wing of the dam, on the easterly portion of the Middle dike and on the East dike and Waste-weir. These camps contain about 40 buildings. Medical attendance is provided by the contractor and the sanitary condition of all quarters is frequently inspected.

The work done on the principal items under Contract 3 is given below:

PROGRESS ON CONTRACT 3—1908

ITEM	To Dec. 31, 1908	TOTAL ESTIMATED AMOUNT TO BE DONE
Earth excavation.....	353,877 cubic yards	2,055,000 cubic yards
Rock excavation.....	46,758 cubic yards	425,000 cubic yards
Embankment and refill.....	286,734 cubic yards	7,055,000 cubic yards
Concrete masonry.....	15,965 cubic yards	280,000 cubic yards
Cyclopean masonry.....	25,270 cubic yards	530,000 cubic yards
Concrete blocks.....	200 cubic yards	64,000 cubic yards
Vitrified pipe.....	11,304 feet	21,500 feet
Clearing.....	141.5 acres	200 acres

KINGSTON SEWER

Contract 5, Haggerty Contracting Company, Contractors.

Work under Contract 5 was resumed March 30 and was completed in June. The amount of work done is given below:

CONTRACT 5—TOTAL AMOUNT OF WORK DONE

ITEM	IN 1907	IN 1908	TOTAL
Earth excavation...	2,715 cubic yards	2,889.5 cubic yards	5,604.5 cubic yards
Rock excavation....	55.8 cubic yards	14.45 cubic yards	70.25 cubic yards
24-inch vitrified pipe	2,263 feet	2,566.8 feet	4,829.8 feet
24-inch cast-iron pipe	58.2 feet	14.0 feet	72.2 feet
Manholes.....	10	10	20

NORTHERN AQUEDUCT DEPARTMENT

ROBERT RIDGWAY, *Department Engineer*

The Northern Aqueduct department comprises that portion of the Catskill aqueduct between the upper end of the Esopus siphon and the north side of Hunters brook valley. It extends over a length of 60.2 miles from the headworks at the Ashokan reservoir to the edge of the Croton watershed. The limits and alinement of the five field divisions have remained practically the same as at the end of 1907, and the Executive division still occupies the same quarters at Poughkeepsie.

ORGANIZATION

DIVISIONS AND EMPLOYEES

Department headquarters were maintained in the Poughkeepsie Trust Company building at 236 Main street, Poughkeepsie.

NUMBER OF MEN ON DEPARTMENT PAYROLLS DURING 1908

	AVERAGE FOR YEAR	MAXIMUM	DATE	MINIMUM	DATE
Monthly payroll (engineers and clerks)	154	166	Dec. 23	142	Apr. 8
Weekly payroll (laborers and inspectors)	37	51	Sep. 30	20	Jan. 15

The total number on the rolls at the beginning of the year was 184, and at the end of the year 209. A considerable number of laborers were employed in the Esopus, Wallkill and Newburg divisions on test-pits and borings. During the year the division organizations remained practically unchanged from the previous year, but the section organization was partially completed in the Esopus division, where practically the entire work was placed under contract. In the Esopus and Peekskill divisions work was carried on by organized sections, while in the Wallkill, Newburg and Hudson river divisions the field-work was carried on from the division offices. In the Wallkill division, one of the five sections was organized for the construction work on Contract 15.

EXECUTIVE DIVISION

R. N. Wheeler, Division Engineer, 236 Main street, Poughkeepsie.

The average force employed in this division was 25 men, of whom a large proportion were engaged in routine clerical work incidental to handling the correspondence and supplies of the department. There is also a drafting force of five or six men, and a computing force of three or four men.

ESOPUS DIVISION

L. White, Division Engineer, High Falls, N. Y.

The force employed during the year averaged 37 men, who were engaged for the first half of the year on surveys and studies for Contracts 11 and 12, and for the latter half of the year on engineering work and inspection in connection with the construction work on these contracts. During the first four months of the year the division office was located in a private house at High Falls, the same quarters as last year, but on May 1 the entire office was moved to the new temporary field office built by the Board, a one-story building 43 feet by 83 feet in plan, on the road between High Falls and Stone Ridge.

The office work on Contract 11 was done at the division office, where the section force on the Rondout siphon, Contract 12, was also located. A division and section office is under construction at High Falls on the same lot with the temporary field office.

WALLKILL DIVISION

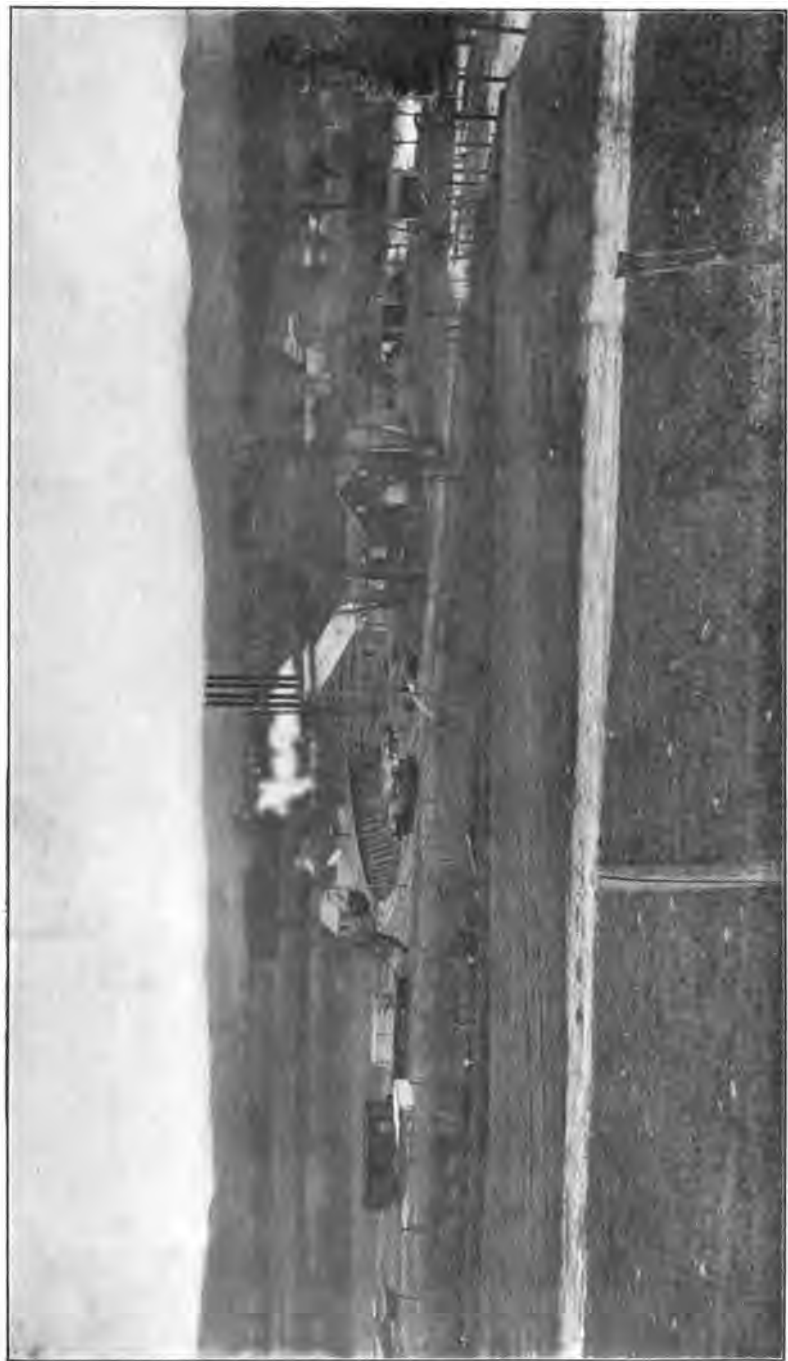
L. C. Brink, Division Engineer, New Paltz, N. Y.

The average force employed during the year was 25 men, of whom a considerable number were laborers; at the close of the year 9 men were engaged on construction work and 17 on surveys, investigations and office work. The quarters occupied by the division office were the same as last year, in the Hasbrouck building in the village of New Paltz. All work was directed from this office.

NEWBURG DIVISION

Alexander Thomson, Jr., Division Engineer, Walden, N. Y.

The average force employed was 25 men, of whom a considerable number were laborers. During the summer men were transferred from the Esopus and Wallkill divisions for work on surveys, test-



CATSKILL AQUEDUCT—Contract 12, Rondout Siphon, November 5, 1908. Power Plant, Coal Trestle, Machine Shop and Contractor's Stables.
Shawangunk Mountains in Background.

pits and soundings. The division office was located in the Edmunds building in the village of Walden, from which point all work in the division was directed.

HUDSON RIVER DIVISION

William E. Swift, Division Engineer, Cornwall-on-Hudson, N. Y.

The average force employed during the year was 25 men engaged in engineering work. The division office continued throughout the year at the Pagenstecher house, which was remodelled by the owner for use as a division and section office.

PEEKSKILL DIVISION

A. A. Sproul, Division Engineer, Peekskill, N. Y.

The average force throughout the year was 56 men, including several inspectors. The engineering work in connection with Contract 2 was carried on under the same section organization as last year. The division and Section 2 offices were moved during January from the temporary quarters in Peekskill to the division and section office built by the Board on the line of the aqueduct taking. Sections 1A and 1B occupied the same quarters as last year. Section 2 occupied quarters in the new division office building. For the first three months of 1908, Section 3 was quartered in rooms in a dwelling house on Gallows hill. The office for Section 3, built by the Board, at Sprout brook, was completed and occupied on April 1, 1908. The construction of section office buildings for Sections 4 and 5, begun during 1907, was completed during the year, and the Section 4 building was occupied on October 1, 1908, when the temporary office at Nelsonville was given up.

SUMMARY OF YEAR'S WORK

The location of the entire line within this department was fixed at the end of the year. At the beginning of the year the general location of the aqueduct throughout the department had been decided, except the Hudson river crossing and its approaches, which, with the Moodna siphon, was the most important matter of location settled during the year. In this connection the Hudson river division ran several lines which were the object of careful survey and study, and required the preparation of many topographic maps and a considerable amount of boring work. A length of 26 miles, or 43 per cent., of the department was under contract at the end of the year.

On the Esopus and Wallkill divisions all but a small amount of the mapping, location and exploration work was completed at the end of 1907. At the end of 1908 the real estate surveys had been completed and the work was ready for contract. During the year two main contracts were let on the Esopus division for the Esopus cut-and-cover and Rondout siphon, and over half a million dollars' worth of work was done under these contracts, exclusive of the preliminary expenditures for plant. One cut-and-cover contract was also let on the Wallkill division. On the Newburg and Hudson river divisions the work consisted mainly of final field location, preparation of real estate maps and contracts, and construction work in connection with test-shafts. On the Peekskill division the work of construction was continued under Contract 2.

The following summary indicates the general conditions at the end of the year as to final location, real estate takings and readiness for contract.

PROGRESS ON CATSKILL AQUEDUCT, NORTHERN AQUEDUCT
DEPARTMENT

	MILES	PER CENT. OF DEPARTMENT TOTAL
Final aqueduct location.....	60.15	100.00
Real estate maps filed.....	60.15*	100.00*
Real estate acquired.....	41.00	68.2
Work ready for contract.....	19.00	31.58
Work under contract.....	26.00	43.4

*"Filed" here means filed and approved by the Board of Estimate.

Ten agreements and one contract for core borings, test-pits and soundings, test-shafts and office buildings were terminated during the year. One agreement was made December 7, 1908, for the rental of plant for use in sinking test-shafts.

Three main contracts, Numbers 11, 12 and 15, for the construction of the aqueduct were let during the year. Contracts 11 and 12 cover the entire Esopus division, with the exception of the Esopus and Tongore creek crossings. Contract 15 covers about 3 miles of cut-and-cover aqueduct in the Wallkill valley, at the southern end of the Wallkill division.

During the year Contracts 15, 16, 17, 18, 19, 21 and 33 were under preparation by the Northern Aqueduct department, and field-work necessary for supplying information in connection with the contracts under preparation by Headquarters department was



CATSKILL AQUEDUCT—Contract 12, November 6, 1908. North Portal of Bonticou Grade Tunnel, Showing Portal Cut from which 11,000 cubic yards of Material were removed and heading started in four and a Half Months after Contract was let.

carried on. At the end of the year, except for two of the main contracts and a few pipe siphons, the entire 60 miles of aqueduct line in the department was ready for letting, but the real estate takings were not made in all cases.

PRELIMINARY WORK

DESCRIPTIONS—LOCATIONS

Slight changes in the approximate amounts and percentages of the several types of aqueduct construction were made, and the quantities as at present determined are as follows:

CATSKILL AQUEDUCT—LENGTHS AND TYPES OF STRUCTURES

TYPE OF AQUEDUCT CONSTRUCTION	MILES IN NORTHERN AQUEDUCT DEPARTMENT	PER CENT. OF TOTAL LENGTH OF NORTHERN AQUEDUCT DEPARTMENT
Cut-and-cover.....	36.0	59.9
Grade tunnel.....	6.1	10.1
Pressure tunnel.....	14.4	23.9
Pipe siphon.....	3.7	6.1

In the 1907 report an account of the proposed structures, their location, accessibility and distinctive features was given. No marked change in these details has taken place during the year, except as follows:

On the long strip of cut-and-cover in the Wallkill valley, a length of about 16 miles between the Wallkill and Moodna siphons, the location of the blow-off to be provided for draining this portion of the aqueduct was tentatively placed about 1 mile south of Ireland Corners. Previous studies for this blow-off were made in 1907 and 1908 at several locations farther south on the Newburg division. On Contract 45, near the south end of the Newburg division, studies were made with regard to the best method of disposing of the drainage of the country across the deep cut on that contract, and the general plan recommended by this department was approved. At the Moodna siphon a location for a pressure tunnel across the valley was decided upon. No certain conclusions with regard to the maximum depth of the Hudson river siphon were reached, as the borings and other explorations at this stream were not completed. At the Peekskill creek siphon no decision was reached regarding the use of a heavy fill for the steel pipes, as the questions affecting the construction of a dam in this valley for the water supply of Peekskill are still undecided.

SURVEYS

A precise level party set about 300 standard secondary benchmarks on the several divisions of the department. On the Esopus division, about 8 square miles of country were surveyed and mapped in connection with running out watershed areas above the cut-and-cover line, where some 45 culverts will be constructed over large and small watercourses. Elevations of precise bench-marks were run and final lines and stations established on construction line monuments on the cut-and-cover and tunnel lines.

In the Wallkill division a wide strip of topography was taken for a length of about 3 miles along the course of the proposed blow-off conduit from the south cut-and-cover aqueduct, Contract 15. Topographical surveys were made to determine the drainage areas tributary to culverts, and numerous small jobs in connection with cross-sectioning spoil areas, checking lines and levels, and obtaining real estate evidence were completed.

In the Newburg division, in addition to a large number of farm surveys, the topography of the entire division was plotted on 21 sheets and field studies made upon alternative locations for the cut-and-cover aqueduct. Cross-sections at 25-foot intervals were taken and plotted for the full width of the right-of-way for the entire length of the division, about 16 miles, a total of about 3,000 sections. Detail cross-section surveys were made at 17 road-crossings and 7 large streams. Construction base-lines were staked out along Contracts 16, 17 and 18. Drainage surveys were made and maps plotted.

In the Hudson river division three lines for the pressure tunnel along Storm King mountain were investigated by profile and topographic surveys. A reconnaissance was made of the Idlewild project for the location of the Moodna siphon. Triangulation and topographic surveys were undertaken along part of that line, and on several trial lines for the Moodna siphon topographic and property surveys were completed and the taping done. More than one-half of the line which was finally selected for the Moodna pressure tunnel was located and precisely taped, and all shaft site topography surveyed. A topographic survey for studying the location of a steel pipe-line across Moodna valley was begun. At the Hudson river soundings and borings were made through the ice, and dry samples of the bottom obtained. Stadia surveys of the areas occupied by the contractor at the east and west shafts were made. A base-line was established and triangulation done in con-

nection with the river borings. At Breakneck mountain topographic surveys and studies were made for an access road to the uptake shaft where detail topography was taken on the mountainside. Cross-sections every 20 feet were taken on the Breakneck cut-and-cover, center line monuments were set, bench levels run, and some farm surveys made in this valley. Line was established over Bull hill for the grade tunnel; on account of the peculiar light conditions, this work had to be done at night.

In the Peekskill division additional surveys were made in connection with the construction work.

SUBSURFACE INVESTIGATIONS

During the year core borings and rod soundings in the entire department were practically completed, with the exception of the Hudson river crossing. In the Esopus division at the Rondout siphon, nine holes were drilled by shot and diamond machines, a total depth of 1,542 feet. Pumping experiments were carried on by a large oil well pump for the purpose of determining the amount of water which would be encountered during the construction of the Rondout pressure tunnel.

In the Wallkill division no additional borings were made, but 130 test-pits were dug and rod soundings made by employees of the Board. In the Newburg division 31 borings were made and about 1,000 soundings and 92 test-pits put down by contractors and employees of the Board.

In the Hudson river division 46 core borings and churn drill borings were made on the Moodna siphon and at Breakneck valley, and 4 deep holes drilled in the Hudson river. Test-pits and rod soundings were made on the cut-and-cover line and soundings and borings in the river for investigating a possible shield tunnel line. No work was done in sinking the test shafts at the Hudson river, which were driven to a depth of about 250 feet by a contractor during 1907, but work of erecting plant was undertaken by employees of the Board in preparation for continuing the excavation of these shafts for the purpose of exploring the bed-rock profile at the Hudson river siphon. Some shallow test-pits and soundings were made in the Peekskill division in connection with the location of the Peekskill siphon.

HYDROGRAPHIC WORK

At each of the field divisions a rain-gage and recording thermometer was maintained and the results of observations forwarded to the hydrographic division of the Reservoir department.

STUDIES AND DESIGNS

PREPARATION OF CONTRACTS

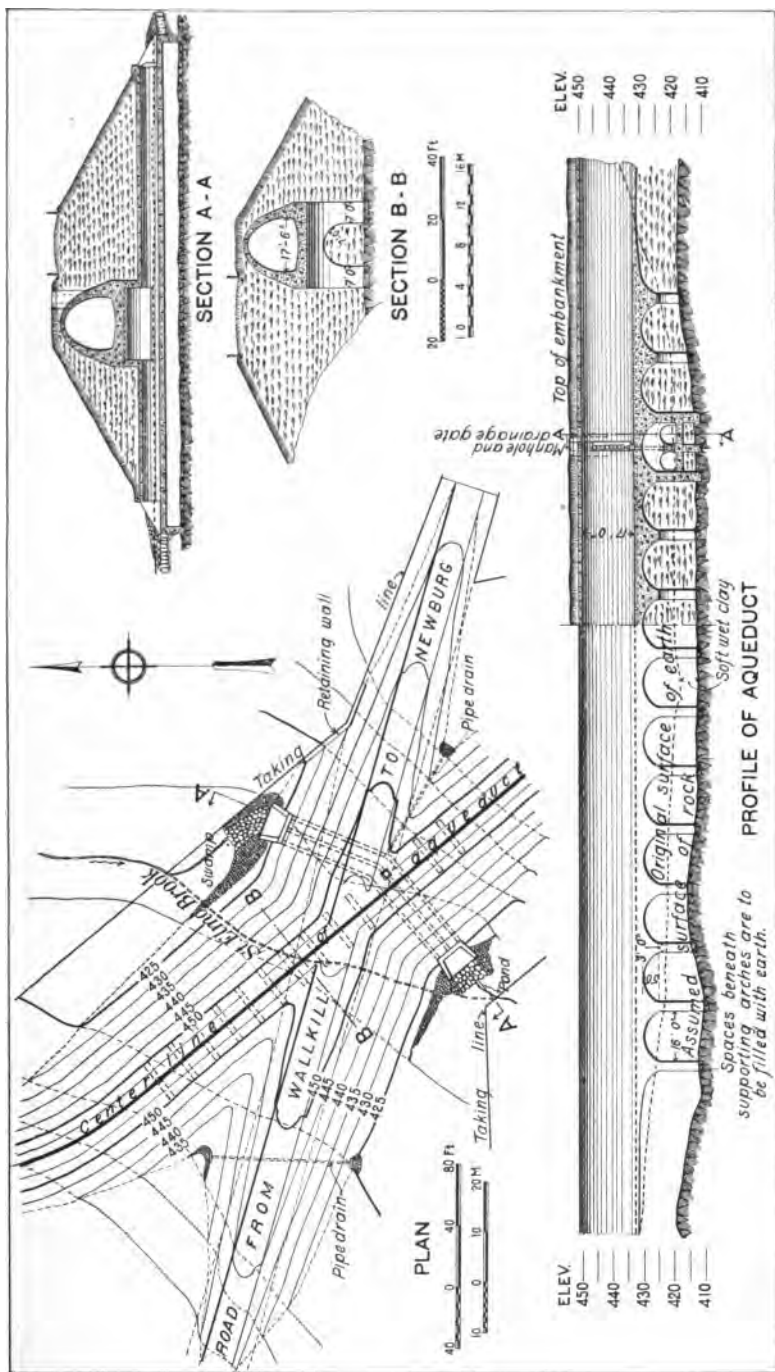
The following contracts were assigned to this department for preparation: 15, 16, 17, 18, 19, 33 and 21. Contract 11, Esopus cut-and-cover, which was prepared by Headquarters department, was designed to serve as a model for remaining cut-and-cover contracts, and for this reason this department collaborated with Headquarters department in the preparation of the important items of the specifications for Contract 11, particularly excavation, refilling, embankment and concrete. In this connection studies were made for support for aqueduct located on side-hill, where the invert rested partly on rock and partly on earth, also for aqueduct running from rock cut on to earth embankment.

Contract 15, Wallkill south cut-and-cover, and Contract 16, Part 1 of the Newburg cut-and-cover, were modelled very closely on the lines of Contract 11. After a study of the test-pits along the line, it was decided to specify aqueduct "in loose earth" for Contract 15, and aqueduct "in compact earth" for Contract 16. The specifications to cover both types of structure and the appropriate payment lines for excavation and masonry were taken, without important changes, from Contract 11.

Contract 17, Part 2 of the Newburg cut-and-cover, was similar to Contract 16, but within the limits of this contract the aqueduct will cross the St. Elmo brook several feet above the present ground surface, and immediately thereafter it will cross the line of the Central New England railroad, where the tracks are about 8 feet above normal invert grade. Preliminary studies were made by this department, and afterwards taken up and completed by Headquarters department, for building the aqueduct across the St. Elmo brook on concrete piers and arches, and for a stretch of about 300 feet depressing the aqueduct about 15 feet to pass under the tracks of the railroad without changing their grade. Drawings and specifications to cover these special structures were included in Contract 17.

Contract 18, Part 3 of the Newburg division cut-and-cover, differed only slightly from Contract 16.

The preparation of Contracts 19 and 33, Parts 4 and 5 of the Newburg division, were later combined into Contract 45. The conditions requiring special treatment on this contract are the long stretch of deep cut, the invert grade being a maximum of about 60 feet below the surface and more than 25 feet below the surface for



CATSKILL AQUEDUCT—Special construction at crossing of St. Elmo Brook.

a distance of 5,000 feet. A study was made of the possible economy of using the narrow, grade tunnel section of aqueduct through this deep cut. It developed that although the concrete and excavation required for the narrow section were considerably less than for the standard cut-and-cover section, yet the ensuing loss of head requiring a deeper cut for the cut-and-cover aqueduct south of that point, and an enlargement of the Moodna siphon cross-section to compensate for the loss, would result in a large increase in the total cost. Three depressions will be crossed by the aqueduct on this contract and require heavy foundation embankments on account of their length and depth. This contract is in the course of preparation.

GENERAL STUDIES BY DIVISIONS

During the year a revised hydraulic grade sheet was issued, on which a number of modifications were made which affected to some extent the field-work in several divisions. In the Esopus division the slope of the aqueduct on the cut-and-cover work north of the Peak tunnel was slightly increased to provide for the greater fouling effect expected in this stretch. A study of the drainage problems and the design of culverts, about 45 in number, on the Esopus division was about 50 per cent. completed. During the year the final grade of the Rondout pressure tunnel was established by Headquarters department, based on recommendations of this department after a careful study and consideration of the many borings, pumping experiments and pressure tests, and cost data furnished by the experimental tunnels.

In the Wallkill division a study was made for Headquarters department for the aeration of water at the Ashokan reservoir, and surveys and studies for a blow-off to deliver about 1,000 cubic feet per second from the cut-and-cover aqueduct on Contract 15 to the Wallkill river. Progress was made on the studies for the location and design of culverts on the three cut-and-cover contracts of the division.

In connection with the location of the aqueduct on the Newburg division a number of estimates were made comparing alternative routes. Detailed studies of the drainage and design of several large culverts were also made.

On the Hudson river division study of the relative merits of a cut-and-cover location on the side of Storm King mountain and of a pressure tunnel along its base showed little choice in cost or time, but the latter showed most advantages. A report on several projects



CATSKILL AQUEDUCT—Contract 12, Rondout Siphon, September 17, 1908. Forms and Steel Shoe for Bottom of Reinforced Concrete Caisson at Shaft 2.

involving the construction of a deep pressure tunnel, free draining pressure tunnel east of Moodna creek, and pipe-lines in several combinations, indicated that a deep pressure tunnel for the full width of this valley will be the cheapest and most permanent structure, and a recommendation to this effect was made by the division and department engineers. In connection with the Hudson river siphon, additional studies were made comparing the merits of various types of structure. The relative advantages of vertical shafts and inclines were studied in connection with the proposed exploration by shaft sinking and diamond drill holes undertaken by the forces of the Board. Studies were continued in connection with the disposal of spoil and the design of shafts and tunnel from the Hudson river through Breakneck mountain. Further studies were made for a blow-off in Breakneck valley. Designs were prepared for the plant and equipment for use in sinking the experimental shafts at the Hudson river. Information was furnished Headquarters department for the preparation of Contract 20 for Moodna siphon and contract 22 for Bull hill tunnel and adjacent stretches of cut-and-cover aqueduct.

In the Peekskill division the test sections of reinforced concrete aqueduct built last year at Hunters brook siphon were taken in charge by Headquarters department and tested during the spring. A number of special designs were made of minor structures in connection with the drainage, disposal of spoil and handling of materials.

REAL ESTATE

During the year, title to the necessary real estate from the north end of the Wallkill siphon to the Ulster-Orange county line, a distance of 11.2 miles, passed to The City. At the end of the year, the title to the necessary real estate between the north end of the department and the Ulster-Orange county line, a distance of 28.7 miles, and between the southern end of the department and the Healy-Moffat road, a total distance of 12.8 miles, had passed to The City, leaving 18.7 miles to be acquired.

At the end of 1908 real estate maps for the entire department were plotted. In the Hudson river division, on account of the late decision fixing the location of the Moodna siphon, the real estate maps on Sections 7 and 8 were delayed in preparation until late in the year.

CONTRACTS AND AGREEMENTS

AGREEMENTS

At the beginning of the year ten agreements for core borings, test-pits and soundings, test shafts and office buildings were in force. Under these all the subsurface investigations except those at the Hudson river siphon, contemplated for this department by borings, test-pits and soundings, beside three office buildings on the Peekskill division and one office building on the Esopus division, were completed. One agreement, Number 72, was made during the year, on December 7, 1908, with J. S. Mundy for the rental of plant to be used in sinking the test shafts on the shores of the Hudson river.

CONTRACTS

One major and two minor contracts were in force at the beginning of the year, as follows:

Contract 1, a minor contract, for test-borings into the rock in the channel and on the shores of the Hudson river, was entered into March 1, 1906, with the American Diamond Rock Drill Company. On February 21, 1908, the contract was assigned to the Phoenix Construction Company of New York. The contract will expire January 1, 1909.

Contract 2, a major contract, entered into April 10, 1907, with the Thomas McNally Company of Pittsburg, Pa., provides for the construction of portions of the Catskill aqueduct on the Peekskill division, consisting of 8.5 miles of cut-and-cover and 2.8 miles of grade tunnel. This contract was in force throughout the year.

Contract 4, a minor contract, was entered into on August 12, 1907, with Daniel Carpenter, of Ossining, N. Y. Under it a division and section office building for the Peekskill division was constructed in the Town of Cortlandt, near Peekskill, and the contract terminated.

Three major and one minor contracts were made and continued in force during the year, as follows:

Contract 11, a major contract, entered into on August 5, 1908, with Stewart-Kerbaugh-Shanley Company of New York, provides for the construction of portions of the Esopus division of the Catskill aqueduct, consisting of 5.9 miles of cut-and-cover and 0.7 miles of grade tunnel. The estimated cost of the work under this contract is \$2,363,920.00.



CATSKILL AQUEDUCT—Contract 2, October 16, 1908. Peekskill cut-and-cover.
Plant used for concreting aqueduct on Section 1-B. Smith Batch Mixer
mounted on traveler with overhead materials' track



Contract 12, a major contract, entered into on June 12, 1908, with The T. A. Gillespie Company of Pittsburg, Pa., provides for the construction of the Rondout siphon, a pressure tunnel 4.5 miles in length, and the northern half of the Bonticou grade tunnel, 0.7 of a mile in length. The estimated cost of the work under this contract is \$6,290,803.50.

Contract 15, a major contract, entered into on September 9, 1908, with the Elmore and Hamilton Contracting Company of Albany, N. Y., provides for the construction of a three-mile stretch of cut-and-cover aqueduct at the south end of the Wallkill division. The estimated cost of the work under this contract is \$933,867.50.

Contract 6, a minor contract, entered into May 12, 1908, with John J. McLean of New York City, provides for the construction of a division and section office building for the Esopus division near High Falls, N. Y. The estimated cost of the work under this contract is \$8,965.

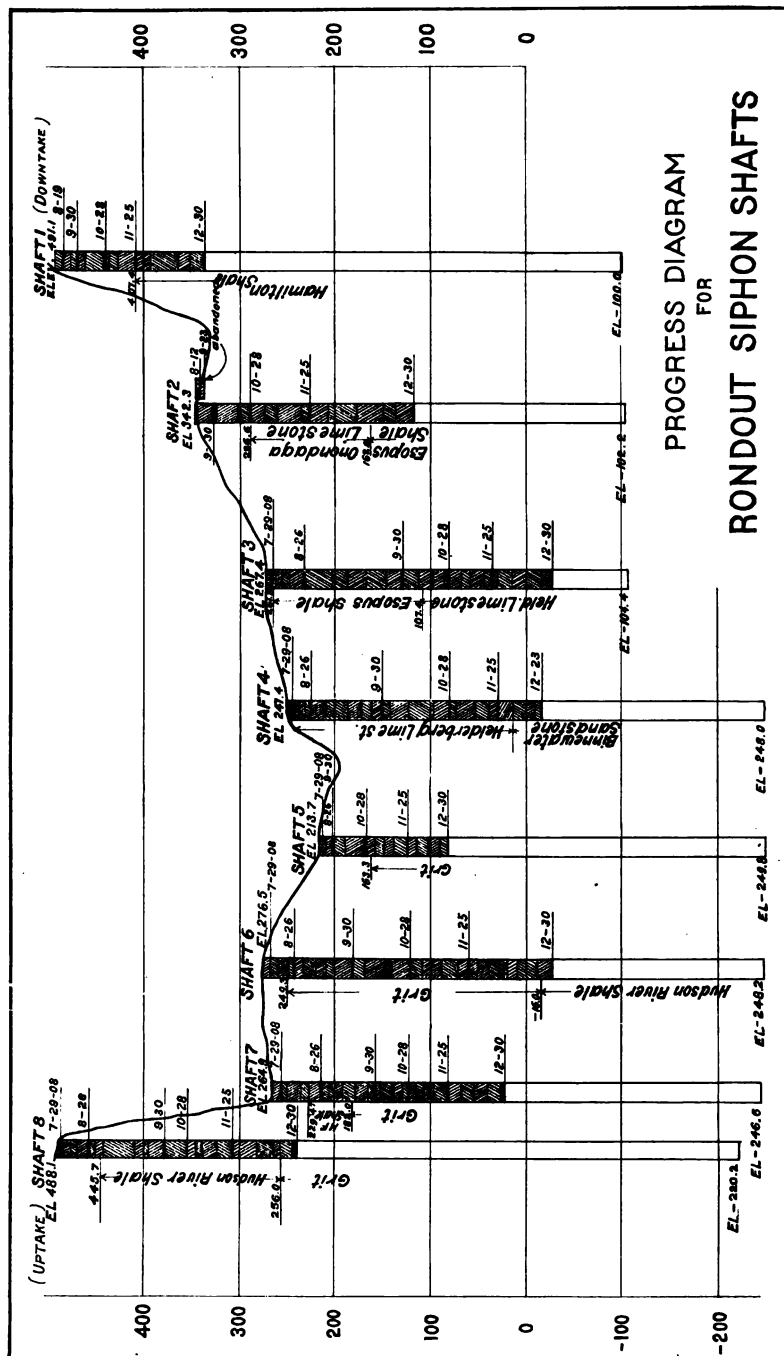
CONSTRUCTION

CATSKILL AQUEDUCT—PORTIONS OF ESOPUS DIVISION

Contract 11, Stewart-Kerbaugh-Shanley Company, Contractor

This contract comprises the northern part of the Esopus division and consists of 6.4 miles of cut-and-cover work and 0.7 mile of grade tunnel. In addition to the work on this contract, two short siphons will be constructed under a separate contract to complete the stretch of aqueduct between the Reservoir department and the Rondout siphon.

Work done by Contractor. On July 28 this contract was awarded, the contractor was ordered to proceed on August 5, 1908, and work was started by the contractor August 10. The contract work to date has consisted of clearing and stripping top-soil over the entire line, building culverts, excavating approach cuts to both portals of the Peak tunnel, and starting excavation of the aqueduct trench. Three per cent. of the total work was completed at the end of the year. The principle difficulty in this work is the transportation problem owing to the inaccessibility of the line, much of which is located on hillsides, remote from railroads, and accessible only by country roads. The contractor has done much to overcome these difficulties by establishing a large receiving and storage yard at the New York, Ontario and Western railroad, near High Falls, whence traction trains haul supplies to the work over roads macadamized



CATSKILL AQUEDUCT—Rondout Siphon Shaft sinking during 1908.

at the expense of the contractor. Six and a half miles of roads were heavily macadamized and four traction trains were placed in daily operation hauling supplies and materials. Six steam shovels were transported along the roads to the site of the work, and during December all of them were in operation. A high-tension electrical transmission line was under construction from High Falls to the Peak tunnel, to furnish power for the tunnel work and a 4-inch pipe-line was laid to supply water by gravity from a six-million-gallon reservoir on a large stream. In addition, a reserve pumping plant of 500 gallons per minute capacity was installed at Esopus creek to provide for dry weather conditions. Briefly, the work to date has consisted for the most part in preparation for the prosecution of the work in the spring.

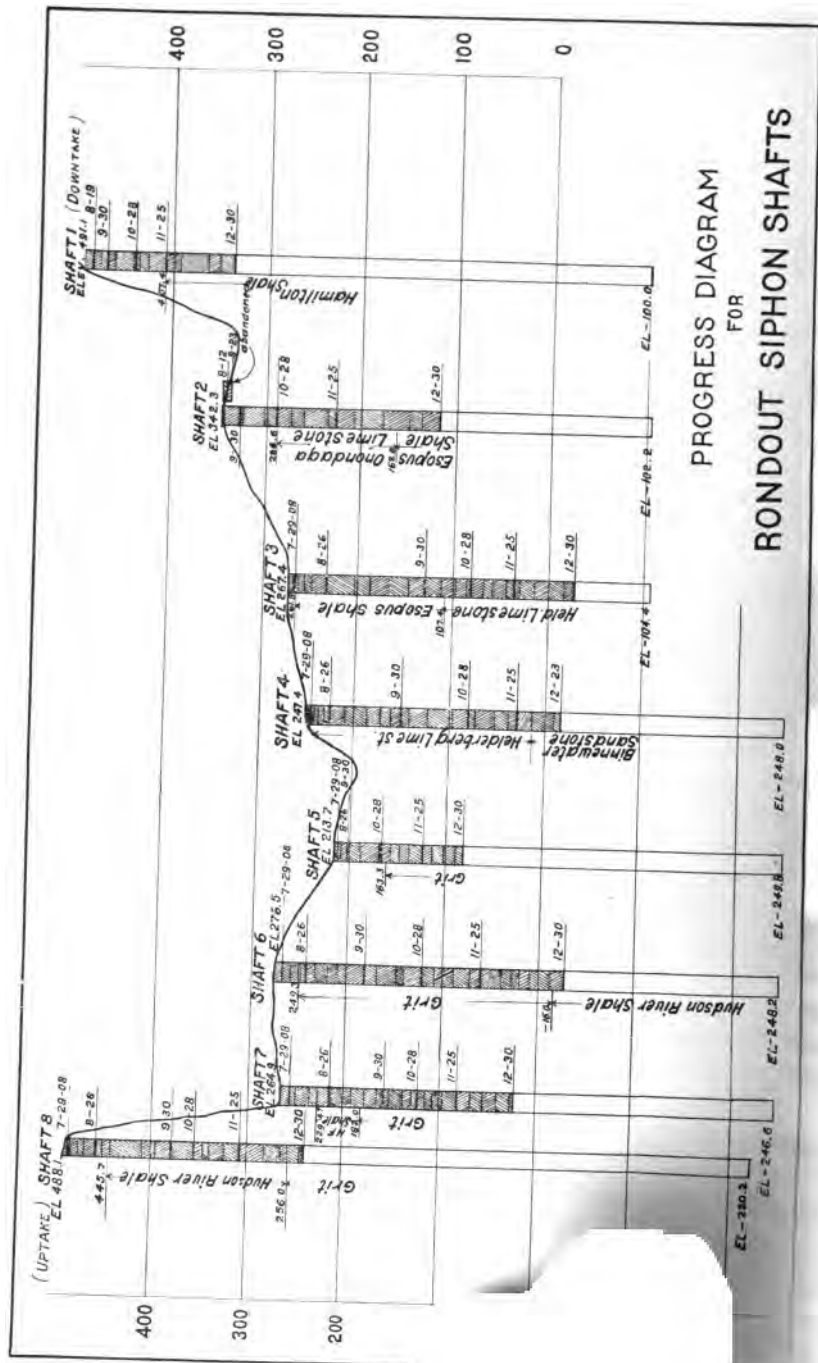
The contractor has proposed a method of construction which involves spoiling all excavated material and borrowing refill at points off the City's property, where the necessary rights have been acquired by the contractor. Application was made for a modification of Contract 11, to permit the use of this method without extra expense to The City. A complete and self-contained concrete plant, built of structural steel and weighing about 90 tons, was designed and its construction begun. Two camps were established, one at Atwood accommodating 300 men, and one at the south portal of Peak tunnel for 200 men. The average force employed on this contract since August 10 was about 356 men and 59 animals, with a maximum of 821 men on December 16.

Contract 12, The T. A. Gillespie Company, Contractor

The contract includes about $4\frac{1}{2}$ miles of deep pressure tunnel and 0.7 mile of grade tunnel, and a few hundred feet of cut-and-cover work. For the construction of the deep pressure tunnel, eight shafts are necessary. The grade tunnel is to be excavated from one portal.

Work done by Contractor. This contract was awarded on June 9, 1908, the contractor being ordered to proceed on June 16. Excavation on the first shaft was begun July 23. Work during the year consisted of sinking eight shafts and providing the necessary equipment, the construction of a large power-plant and appurtenances, storehouses, office buildings, camps, pipe-lines, electric lighting and telephone lines, the construction of roads and a bridge over the Rondout creek.

Temporary plants at each shaft were assembled pending the construction of the permanent power-plant, and the work from the



PROGRESS DIAGRAM
FOR
RONDOUT SIPHON SHAFTS

PROPERTY AVOIDED—Rondout Siphon Shaft sinking during 1908.

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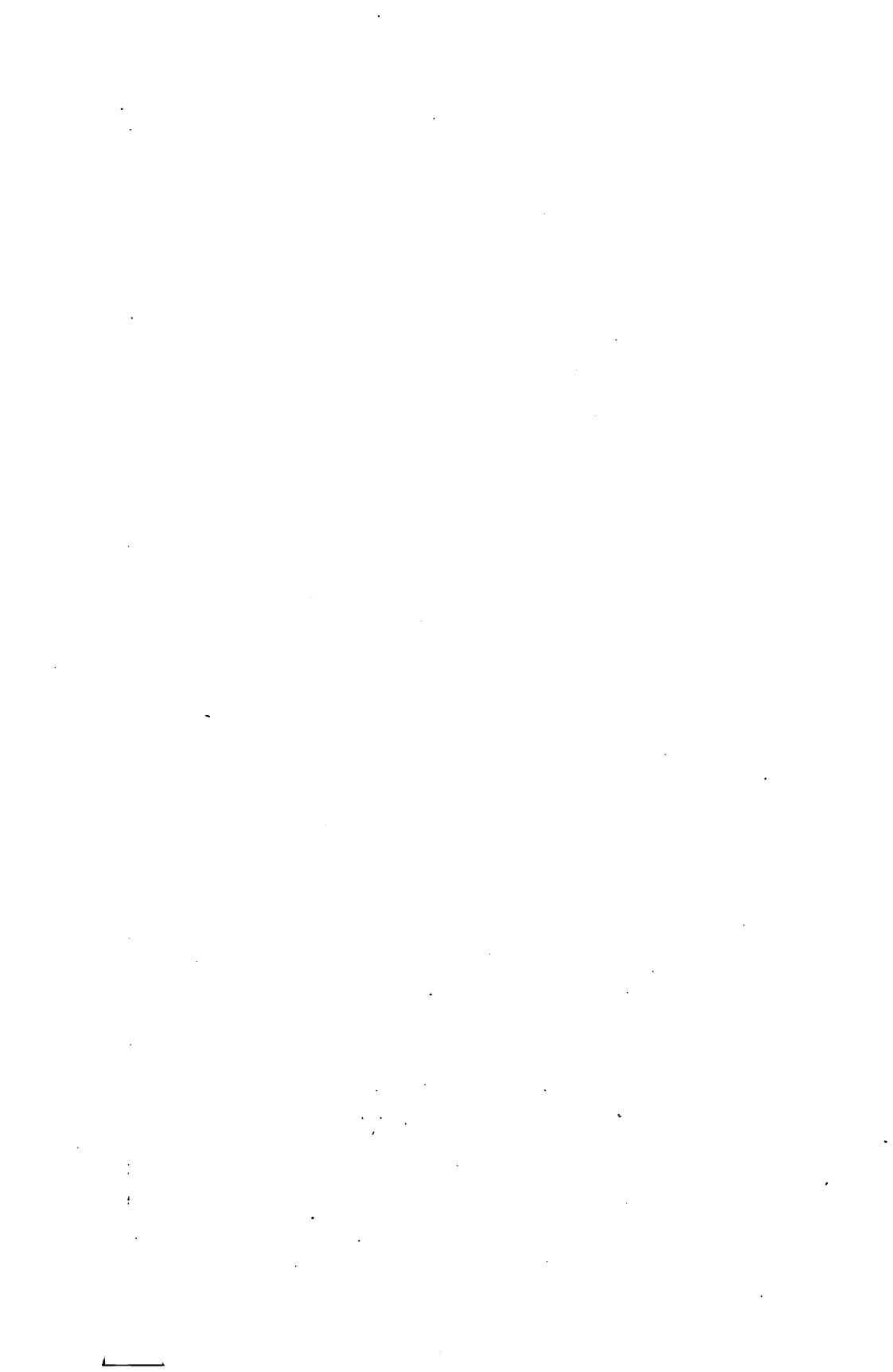
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September 17; work of excavating top-soil was begun on September 18, and by the end of the year was completed over the entire line. The excavation of aqueduct trench was carried on by two steam-shovels serving wagons and by ploughs and drag scrapers. On December 12 work was practically shut down for the winter. The force employed varied from 50 men and 15 teams to a maximum of 130 men and 30 teams; 90 men and 22 teams employed at the end of the year.

PORTIONS OF THE HUDSON RIVER DIVISION

TEST SHAFTS

No work on the excavation of the test shafts was done during the year under Agreement 37. The Cranford Company sunk these shafts to a depth of about 250 feet during 1907, but the agreement was terminated on February 28 by the Board of Water Supply before the completion of the amount of work originally contemplated. On October 6 the Board began the continuation of this work with its own employees. An agreement was entered into for the rental of hoisting machinery, and arrangements were about completed for the rental of a compressed air power plant, which it is proposed to locate near the Cornwall station of the West Shore railroad, for supplying power to the west shaft. A 125-horse-power boiler was moved to a position near the west shaft to furnish power for the hoists, and a new hoisting engine was set up. To prevent the inflow of ground-water from above the rock, a concrete collar averaging 12 feet in height and 2 feet in thickness was laid upon the rock ledge. Concrete retaining-walls were built for two sides of a building for the hoisting plant. A large amount of open-cut excavation was made in connection with an access road and site for the hoist houses on the mountainside.

At the east shaft it is proposed to employ a plant, consisting of two Sullivan compressors, each of a capacity of 1,140 cubic feet of free air per minute and two 125-horse-power boilers. A new mine hoist has been installed and a timber head frame erected. A concrete collar similar to that at the west shaft was built, a number of small buildings were constructed, and a water-supply for operating the plant was developed. At the end of the year about 90 men were employed on this work at both shafts.

PORTIONS OF THE PEEKSKILL DIVISION

Contract 2, Thomas McNally Company, Contractor

This contract has been in effect during the entire year.

Work done by Contractor. In connection with the construction of the open-cut aqueduct and tunnels on this contract, considerable improvement was made in the plant and transportation facilities over those provided last year, but progress was unsatisfactory and not up to the contract requirements, particularly on the work south of Peekskill creek. About the middle of November construction work on the contract practically came to a standstill on account of financial difficulties of the contractor, and most of the men were laid off.

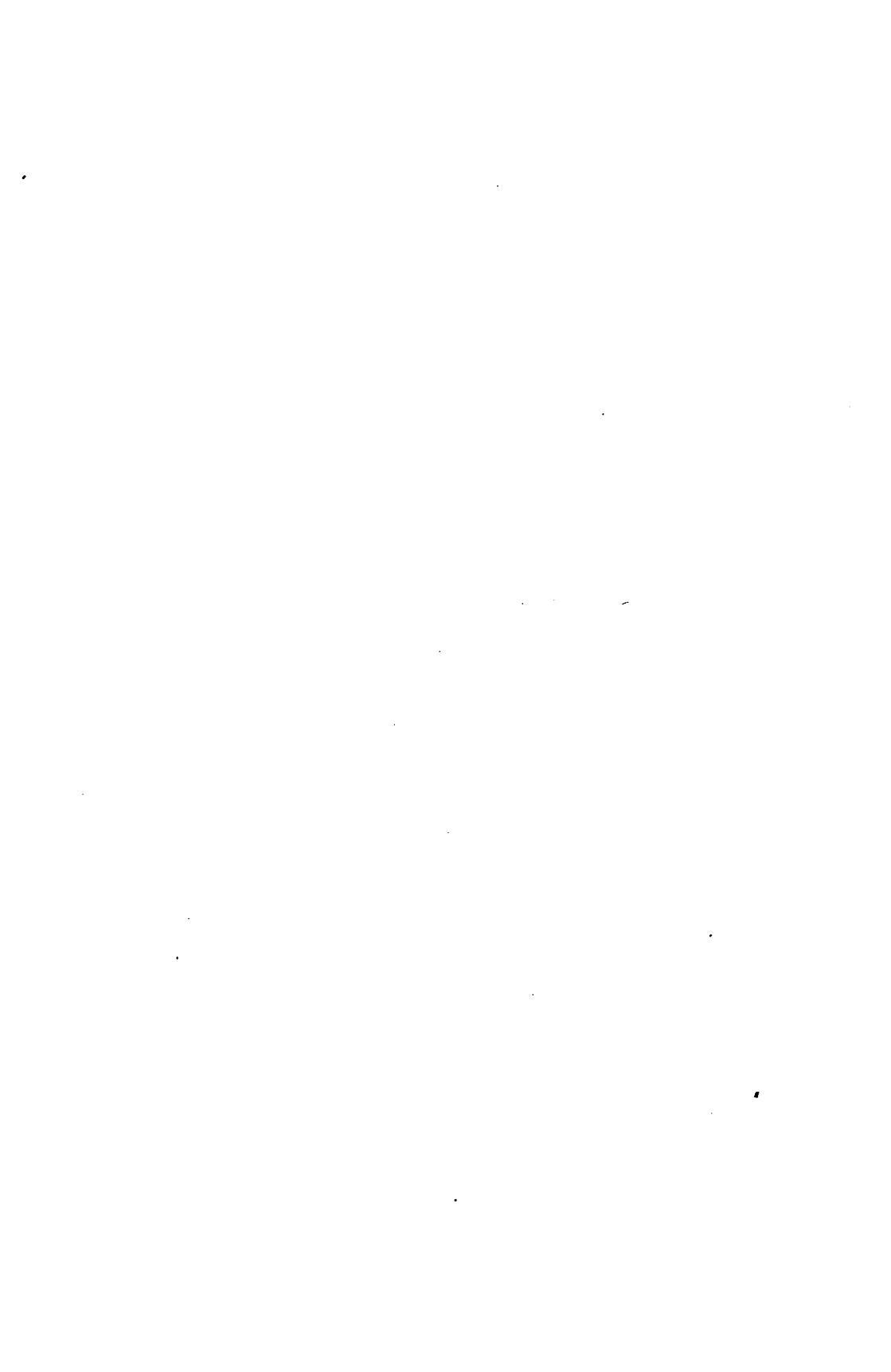
On the upper 1.6 miles of the contract no work was done other than clearing off some of the timber. On the Garrison cut-and-cover, south of Indian brook siphon, one steam-shovel worked on the excavation of the aqueduct trench over a length of about 7,500 feet of line, which was partially excavated. Some work of draining and road building was accomplished, and a minor amount of excavation for the culvert at Phillipse brook crossing.

At the Garrison tunnel, work at the north portal was continued during part of the year, but owing to difficulties with water and the soft ground encountered the heading was driven only 55 feet. A small pump-shaft was put down to drain the ground, and later a large shaft was driven to the rock, from which a top heading was run about 28 feet. It will be possible to drive the rock tunnel south from this new shaft and avoid the slow progress in completing the soft groundwork which would be entailed without the shaft. At the main shaft, near the center of the tunnel, the installation of hoisting machinery was completed, headings driven north and south for a total length of 1,168 feet, and bench removed for a total length of 1,125 feet.

At the Continentalville cut-and-cover one steam-shovel was in operation on the approach cut to the south portal of Garrison tunnel. At the Cat hill tunnel the north heading was driven from the portal for a length of 812 feet, and the north bench was excavated for a length of 273 feet. At the south portal the heading was driven for a total length of 866 feet, and the south bench was excavated for a length of 268 feet. At the Cat hill cut-and-cover one steam-shovel was in operation during part of four months excavating aqueduct trench. At the Peekskill cut-and-cover, a length of 20,500 feet, the work consisted of excavation of



CATSKILL AQUEDUCT—Contract 2, August 25, 1908. Peekskill cut-and-cover, Section 1-B. Concreting Aqueduct Invert. Track leads to Concrete Mixer on Right of Trench



aqueduct trench, construction of rolled foundation embankment and cover embankment and placing concrete. Four steam-shovels were in use at intervals during the year. Five culverts were completed, making a total of 13. At the end of 1907 none of the permanent concrete aqueduct structure had been built. During the past year the following concrete masonry was placed:

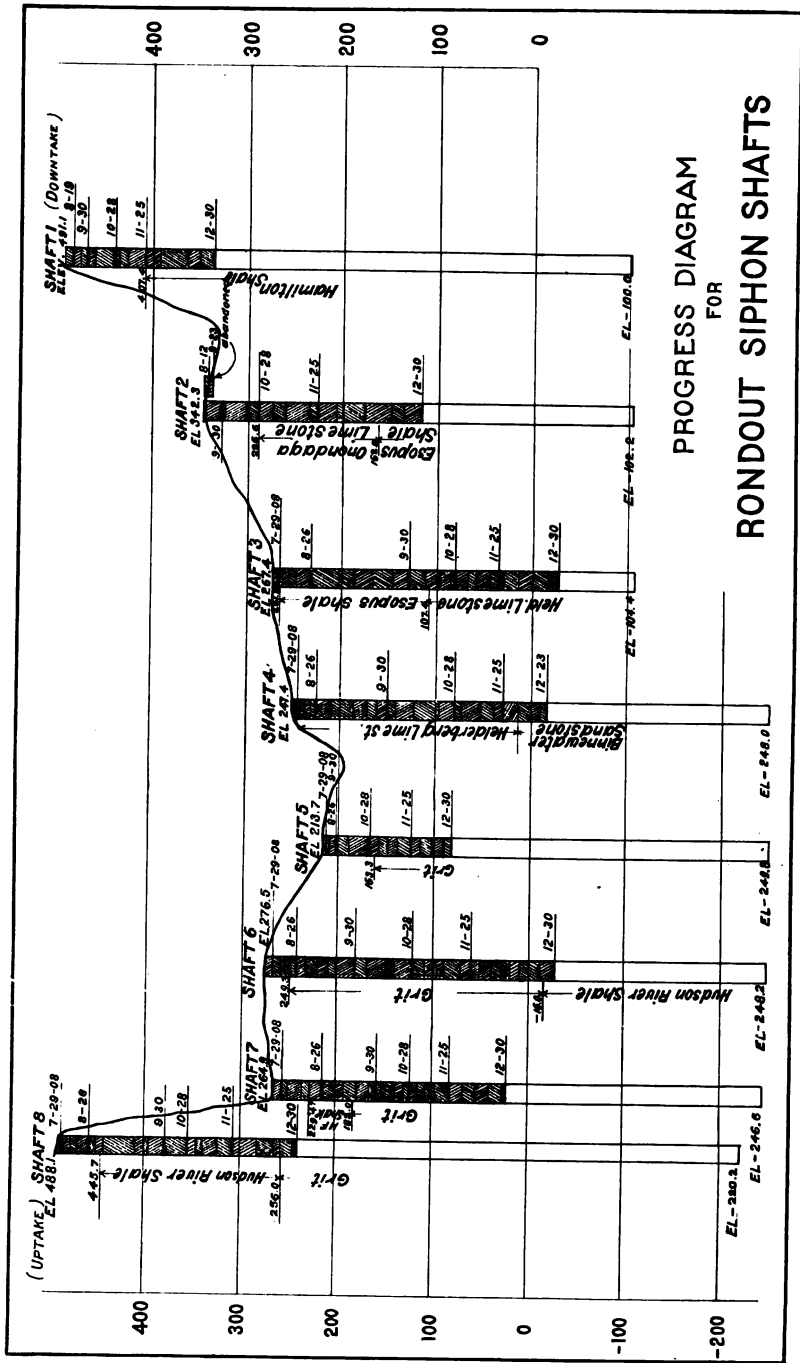
AQUEDUCT CONCRETE PLACED UNDER CONTRACT 2

Concrete invert key blocks.....	305
Aqueduct invert.....	4,385 feet
Aqueduct arch.....	1,485 feet

Concrete Aqueduct Construction. The work of placing aqueduct arch was undertaken at three points on the line of the Peekskill cut-and-cover. The first aqueduct concrete was deposited in building a key-block on April 28. The plant used for laying most of the key-blocks and invert consisted of small Smith mixers, installed at one side of the aqueduct trench and arranged to serve a car running on a track supported by low trestles upon the invert or foundation prepared for same. The concrete was dumped from these cars and shovelled into position, the top surface being finished by screeding from side to side between key-blocks 15 feet apart.

Concreting Plants. Three distinct plants were used for laying arch concrete, and of these one has undergone many radical changes since starting the work. All of the plants for building aqueduct were served by locomotives and trains on 3-foot gage tracks running to the cement shed, sand-pit and two crusher-plants. The plant used on Section 2 consists of a Number 3 Foote continuous mixer, mounted upon a traveler supported by rails laid on the concrete invert slightly outside of the interior of the aqueduct. The various hoppers for the mixer were served by a locomotive crane mounted upon a similar traveler. The concrete was delivered by the mixer to end-dumping cars running on parallel tracks above the top of the arch.

On Section 1-A, south of Station 202, the concrete for key-blocks and invert was mixed in a stationary Hains mixer and conveyed in bottom dumping buckets on platform cars by locomotives to the trench, and there transferred to the work by means of a locomotive crane. For all aqueduct arch thus far constructed, collapsible steel inside forms were used, while the outside forms consisted of steel frames connected by rods or wires to the inside forms and lagged with tongued-and-grooved flooring, calked with oakum and held in



CATSKILL AQUEDUCT—Rondout Siphon Shaft sinking during 1908.

at the expense of the contractor. Six and a half miles of roads were heavily macadamized and four traction trains were placed in daily operation hauling supplies and materials. Six steam shovels were transported along the roads to the site of the work, and during December all of them were in operation. A high-tension electrical transmission line was under construction from High Falls to the Peak tunnel, to furnish power for the tunnel work and a 4-inch pipe-line was laid to supply water by gravity from a six-million-gallon reservoir on a large stream. In addition, a reserve pumping plant of 500 gallons per minute capacity was installed at Esopus creek to provide for dry weather conditions. Briefly, the work to date has consisted for the most part in preparation for the prosecution of the work in the spring.

The contractor has proposed a method of construction which involves spoiling all excavated material and borrowing refill at points off the City's property, where the necessary rights have been acquired by the contractor. Application was made for a modification of Contract 11, to permit the use of this method without extra expense to The City. A complete and self-contained concrete plant, built of structural steel and weighing about 90 tons, was designed and its construction begun. Two camps were established, one at Atwood accommodating 300 men, and one at the south portal of Peak tunnel for 200 men. The average force employed on this contract since August 10 was about 356 men and 59 animals, with a maximum of 821 men on December 16.

Contract 12, The T. A. Gillespie Company, Contractor

The contract includes about $4\frac{1}{2}$ miles of deep pressure tunnel and 0.7 mile of grade tunnel, and a few hundred feet of cut-and-cover work. For the construction of the deep pressure tunnel, eight shafts are necessary. The grade tunnel is to be excavated from one portal.

Work done by Contractor. This contract was awarded on June 9, 1908, the contractor being ordered to proceed on June 16. Excavation on the first shaft was begun July 23. Work during the year consisted of sinking eight shafts and providing the necessary equipment, the construction of a large power-plant and appurtenances, storehouses, office buildings, camps, pipe-lines, electric lighting and telephone lines, the construction of roads and a bridge over the Rondout creek.

Temporary plants at each shaft were assembled pending the construction of the permanent power-plant, and the work from the

KENSICO DIVISION

Wilson Fitch Smith, Division Engineer, Valhalla, N. Y.

This division includes the Kensico reservoir, dam and dike, influent and effluent gate-houses, by-pass aqueduct, aeration plant and aqueduct south of the reservoir to the north end of the Kensico siphon. The aqueduct portion is about 3.4 miles in length. The work has consisted principally in completing topographic and real estate surveys and maps, preparing plans for land takings, locating new highways, by-pass aqueduct and dam, supervising subsurface investigations and preparing estimates of quantities and time for the construction of the Kensico dam.

The office of the Kensico division has remained, as during the previous year, at Valhalla.

WHITE PLAINS AND HILL VIEW DIVISIONS

The field-work on these two divisions has been supervised by the Executive division, some of it under the general direction of Mr. Wells, and some under the immediate direction of Edward A. May, Assistant Engineer. The party at the southern end of the Croton division assisted in some of the land surveys on the White Plains division. The land surveys at the Eastview filters and on the portion of the line north of the filters were made under the direction of the Kensico division.

The White Plains division begins at the north end of the Kensico siphon, a short distance east of the Harlem railroad near the Kensico cemetery station, and extends in a southwesterly direction to the Eastview filters; thence in a southerly direction between the Putnam and Harlem divisions of the New York Central and Hudson River railroad. The southern terminus is in Yonkers, at the north end of the Bryn Mawr siphon, near Central Park avenue, and about one-half mile north of the road from Tuckahoe to Yonkers. This division includes the Eastview filters, and its length is 10.2 miles.

The Hill View division begins at the southern terminus of the White Plains division, and extends southerly to and includes the Hill View reservoir. The aqueduct portion is about 3.7 miles in length.

SUMMARY OF YEAR'S WORK

The final location of the aqueduct in the Croton division was completed, a portion of it was referenced preliminary to construction,



KENSICO DAM—Present Dam looking East; on the Right, Exploration Shaft on One of the Proposed Lines for the New Dam; Proposed Dam will be just outside the limits of the Picture at the Left.

and detailed topographic plans prepared for the more important culverts, highway crossings and spoil-banks. The final line was also located for about one-third of the length of the White Plains division. Contract plans and specifications were made for the greater part of the aqueduct in the Croton division, excepting for the Croton lake siphon, for which plans were prepared at Headquarters department. Topographic surveys and plans for the Kensico reservoir were completed, and those for the Eastview filters and Hill View reservoir were continued. Locations for the Kensico dam and special structures were also made. Subsurface investigations were made in Kensico lake to determine the profile of the dam at the dike sites and at other points in connection with the temporary supply works.

Borings, test-pits and soundings were made along the aqueduct in the Croton division, in the White Plains division north of Hill View reservoir, and at Bryn Mawr siphon. Pumping tests were made from the drill-holes on either side of Croton lake to determine the amount of leakage as an aid in the design of the pressure tunnel at this place. Core borings were also made at the Lakehurst and Dike tunnels.

Real estate plans for the Croton division were completed in May, and condemnation plans were filed in the Westchester county registry in June and October. The City now has title to seven of the ten real estate sections covering the Kensico reservoir.

PRELIMINARY WORK

SURVEYS

Croton Division. Detailed topographic surveys were made for location of culverts, spoil banks, highway crossings, works of sanitation at Croton lake and the Venturi meter near Pleasantville. These surveys covered a total area of about 135 acres. Traverses, with an aggregate length of $7\frac{1}{2}$ miles, were run to determine the drainage areas tributary to various culverts. The aqueduct was finally located for about 6 miles at the south end of the division, completing the final location. The angles and distances were carefully checked, a profile run and the line referenced preparatory to construction. Right-of-way crossings and various access roads were located.

Kensico Division. The topographic survey and plans of the Kensico reservoir were completed and detailed topographic surveys and plans were made of about 166 acres in the vicinity of the influent gate-chamber, tunnel portals and aeration basin. Locations for

aqueduct and by-pass aqueduct and for proposed Rye pipe-line were made. The relocation of a portion of the highway from North White Plains to Armonk was laid out, referenced and cross-sectioned preliminary to construction. A relocation of the highway southeast of Rye pond was also laid out. The highways surrounding the flow-line were surveyed and mapped. The adopted location of the Kensico dam, crossing the present lake, which was adopted early in the year, was located and measured by precise methods. The temporary structures in connection with the new Rye and Bronx dikes, tunnel and other structures were located, referenced and cross-sectioned preliminary to construction; the limits of the drainage area of the Kensico reservoir were located by a stadia traverse, and the greater part of the reservoir taking-line was carefully located and referenced preliminary to construction of walls or fences.

White Plains Division. Topographic surveys and maps were practically completed. These surveys include a considerable extension of the plans for Eastview filters to include ground studied for construction materials, methods, etc. Various preliminary aqueduct lines were run, and a final line was placed on the ground and precisely measured for about one-third the length of the division. Detailed topographic surveys and plans of the more important road-crossings were made.

Hill View Division. Additional topographic surveys and plans, in connection with construction methods and materials at Hill View reservoir and to determine the aqueduct location, were made.

SUBSURFACE INVESTIGATIONS

Croton Division. Four hundred and forty-two rod soundings, with an aggregate depth of 3,355 feet, were made by employees of the Board on the cut-and-cover sections of the aqueduct. One hundred and six test-pits, with an aggregate depth of 691 feet, were dug on cut-and-cover portions of the aqueduct, under Agreement 70. Thirty-three shot drill core borings, with a total depth of 1,590 feet, were made at Hunters brook tunnel, Turkey mountain siphon, Turkey mountain tunnel, Croton lake siphon, Chadeayne tunnel, and at various stations on the cut-and-cover aqueduct, under Agreements 66 and 67. One hundred and twenty-eight wash borings, with an aggregate depth of 1,405 feet, were made on the Pleasantville cut-and-cover and at the portals of the Reynolds hill tunnel, under Agreement 38.

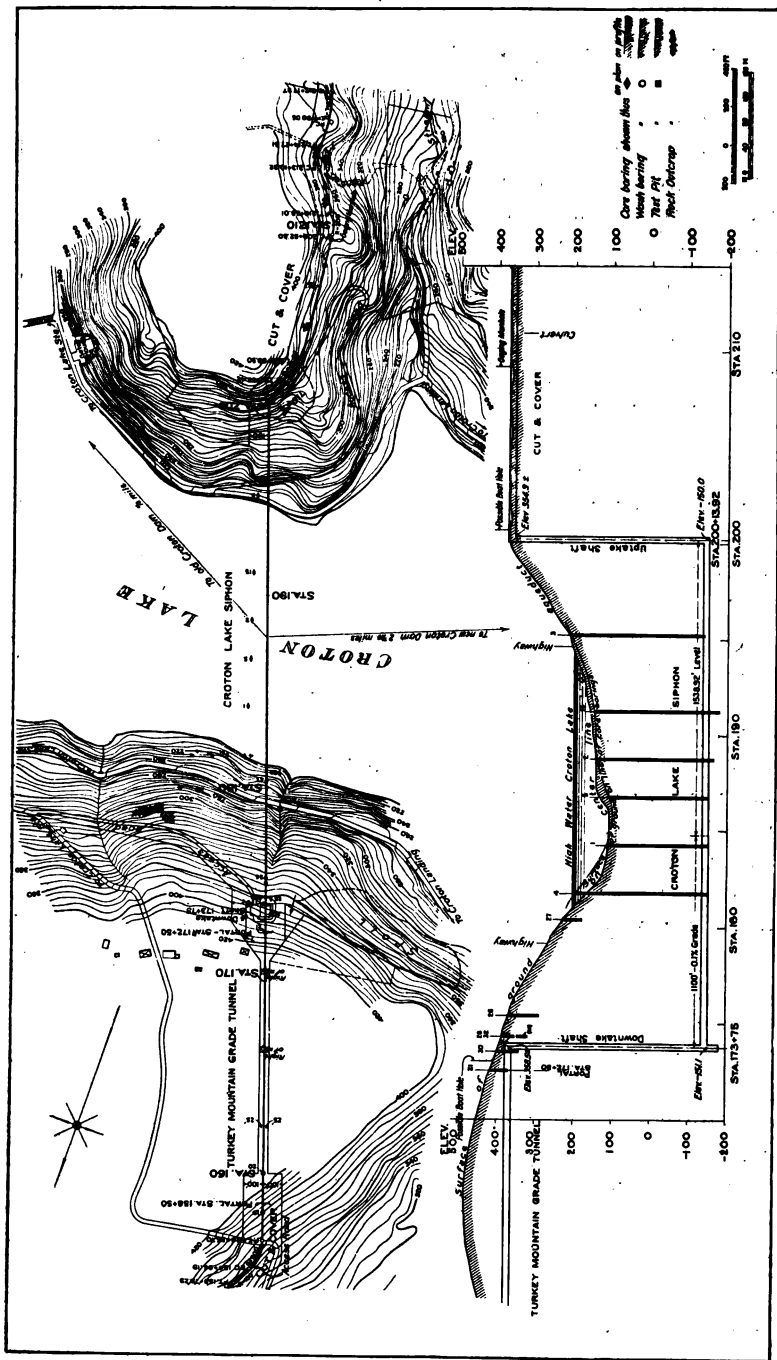
Pumping tests, to determine the leakage into core boring holes

on either side of Croton lake, were made under Agreement 67. These were made with a deep-well pump and hoisting engine. Three tests were made on the north side of the lake, the depths varying from 93 to 280 feet, and with leakage varying from 23 gallons per minute to 46 gallons per minute, the latter rate being the capacity of the pump and not exhausting the water in the hole. On the south side three tests were made, with depths varying from 127 feet to 299 feet, and with leakage varying from 0.5 gallon per minute to 1.7 gallons per minute. Some of these tests were made during 1907, but the data were not put into final shape until the early part of 1908.

Kensico Division. Sixteen wash borings, with an aggregate depth of 1,022 feet, were made in Kensico lake, and 50 wash borings, with an aggregate depth of 643 feet, were made at the proposed Rye dike and highway bridge, the proposed Bronx dike and tunnel and at the site of the Kensico dam spillway. These borings were made under Agreement 38. Twenty-three test-pits, with an aggregate depth of 144 feet, and 7 exploration trenches, with a total length of 643 feet and an average depth of 3 feet, were made at the Kensico dam site, Rye highway crossing, influent gate-chamber, and north portal of Lakehurst tunnel. This work was done largely under Agreement 70. Fifteen diamond drill borings, with an aggregate depth of 1,937 feet, were made in Kensico lake at the proposed site of the Kensico dam and 11 borings, with an aggregate depth of 653 feet, were made at the effluent gate-house and dike tunnel. This work was done under Agreement 44. Sixteen shot drill core borings, with an aggregate depth of 781 feet, were made at the Lakehurst tunnel, at the new Rye and Bronx reservoirs and on the aqueduct line south of the aeration plant. This work was done under Agreements 66, 67 and 71.

White Plains Division. Fifty-eight wash borings, with an aggregate depth of 1,036 feet, were made at the Kensico siphon, Eastview filters, Elmsford siphon and Fort hill siphon, under Agreement 38. Two test-pits, with a total depth of 15 feet, were dug on the Ardsley cut-and-cover by employees of the Board. Ten shot drill core borings, with an aggregate depth of 573 feet, were made at the Eastview and Elmsford tunnels, under Agreements 67 and 71.

Hill View Division. Fifty-one test-pits, with a maximum depth of 43 feet and an aggregate depth of 677 feet, were dug at Hill View reservoir, and in connection with investigations for construction material, under Agreement 70. Nine shot drill core borings,



CATSKILL AQUEDUCT—Croton Lake Siphon Plan and Profile.

with an aggregate depth of 1,676 feet, were made at Bryn Mawr siphon and on the line south of Bryn Mawr siphon, under Agreements 67 and 71.

DESIGNS AND SPECIFICATIONS

Croton Division. Detailed studies for the location of siphon chambers were made and final locations adopted. The hydraulic grade-line was studied in detail and final elevations determined after several conferences with Headquarters department. The sizes of culverts were determined after a detailed examination of the character and extent of the drainage areas.

The work on this division was originally divided into six contracts (excluding pipe siphons). These contracts numbered 23 to 28 inclusive, and, with the exception of Contract 24, the work of preparing the contract plans and specifications was assigned to this department. Contract 23, covering 11,900 feet, includes the Hunters brook and Scribner tunnels and portions of the Yorktown cut-and-cover. These specifications were completed under date of September 1, 1908. Contract 24, which includes the Turkey mountain tunnel, the Croton lake siphon, and portions of the Yorktown and Croton cut-and-cover, is 6,157 feet in length and was prepared at Headquarters department, the specifications being completed under date of September 15, 1908. The location of the Croton lake siphon and the uptake and downtake shafts were determined after study and conference with Headquarters department. As finally located, this siphon is 2,639 feet in length, with shafts about 500 feet in depth. The center line of the tunnel under Croton lake is about 350 feet below the maximum flow-line of the lake. Contract 25 covers 16,950 feet and includes the Croton and Chadeayne tunnels, a portion of the Croton cut-and-cover, the Kitchawan cut-and-cover and the Millwood north cut-and-cover. These specifications were completed under date of November 1.

Contracts 26, 27 and 28 were later combined as Contract 46. This contract is 30,798 feet in length and includes the Putnam siphon, the Millwood, Sarles, Harlem, Pleasantville and Reynolds hill tunnels, and the Millwood south, Sarles and Pleasantville cut-and-cover sections. The Putnam siphon is to be a depressed aqueduct, 16 feet in diameter, of reinforced concrete construction, extending under the Putnam division of the New York Central and Hudson River railroad one-eighth of a mile south of Millwood. The head on the horizontal axis is 26 feet, except for a short distance under the railroad, where it is increased to 45 feet. A Venturi meter is provided for on the Pleasantville cut-and-cover, about

one mile north of the Reynolds hill tunnel. At the end of the year the specifications for the contract were about ready to go to the printer, and the contract plans were nearly completed.

The following table gives the lengths and names of the different types of construction in the Croton division:

CATSKILL AQUEDUCT—TYPES AND LENGTHS IN CROTON DIVISION

STRUCTURE	CUT-AND COVER	GRADE TUNNEL	PRESSURE TUNNEL	PRESSURE AQUEDUCT
Name	Feet	Feet	Feet	Feet
Yorktown cut-and-cover.....	248	.....	.....	.....
Hunters brook siphon.....	.....	.....	.....	1,480
Yorktown cut-and-cover.....	253	.....	.....	.....
Hunters brook tunnel.....	.....	6,150	.....	.....
Yorktown cut-and-cover.....	2,600	.....	.....	.....
Scribner tunnel.....	.....	300	.....	.....
Yorktown cut-and-cover.....	2,684	.....	.....	.....
Turkey mountain siphon.....	.....	.....	.....	1,509
Yorktown cut-and-cover.....	607	.....	.....	.....
Turkey mountain tunnel.....	.....	1,400	.....	.....
Yorktown cut-and-cover.....	125	.....	.....	.....
Croton lake siphon.....	.....	.....	2,639	.....
Croton cut-and-cover.....	2,486	.....	.....	.....
Croton tunnel.....	.....	3,000	.....	.....
Kitchawan cut-and-cover.....	3,500	.....	.....	.....
Chadeayne tunnel.....	.....	700	.....	.....
Millwood north cut-and-cover.....	8,808	.....	.....	.....
Putnam siphon.....	.....	.....	.....	627
Millwood south cut-and-cover.....	3,965	.....	.....	.....
Millwood tunnel.....	.....	4,750	.....	.....
Saries cut-and-cover.....	1,450	.....	.....	.....
Saries tunnel.....	.....	5,230	.....	.....
Pleasantville cut-and-cover.....	118	.....	.....	.....
Harlem railroad siphon.....	.....	.....	.....	687
Pleasantville cut-and-cover.....	165	.....	.....	.....
Harlem railroad tunnel.....	.....	1,100	.....	.....
Pleasantville cut-and-cover.....	700	.....	.....	.....
Pleasantville tunnel.....	.....	700	.....	.....
Pleasantville cut-and-cover.....	7,233	.....	.....	.....
Reynolds hill tunnel.....	.....	3,650	.....	.....
Pleasantville cut-and-cover.....	1,100	.....	.....	.....
Totals.....	36,042	26,980	2,639	4,303

Kensico Division. The location of the Kensico dam, which was adopted during the latter part of 1907, was changed early in the year. The former line was located below the present structure, and the present Kensico lake was to remain undisturbed by the construction of the new dam. The new line crosses the lake about 500 feet above the existing dam. The present lake will be drawn down and temporary storage will be provided for the greater part of the



KENSICO DAM—Site of dam, looking West. Camera about 15 feet below flow line
Trenches on opposite hillside show outline of dam, upper white
post marking top of dam, next below it, the flow line.

drainage area by constructing a temporary reservoir in the Rye basin, raising the water in the present Rye ponds about 20 feet, or to an elevation of about 35 feet below the final flow-line of the new reservoir. The dam, known as the Rye dike, which will flood this basin, is located below the junction of the stream from Rye ponds and Bear Gutter. There will also be a temporary dam crossing the Bronx river, about 3,000 feet north of the present Kensico lake, which will divert the flow of the Bronx river through a tunnel into the new Rye reservoir. The increased storage in this new reservoir, it is estimated, will give as great or greater safe yield than under present conditions of storage. The Bronx pipe-line will be extended from the present dam to the new Rye dike.

Studies were made to determine the elevation, size and location of the by-pass aqueduct, the influent and effluent gate-houses, dike tunnel, aeration plant, Venturi meter and adjacent aqueduct and other structures. The location and general types of construction were substantially decided upon at the end of the year, but final locations for a considerable part of the work had not been placed on the ground. Studies for the location of the temporary storage works, including the Bronx diversion dike, Rye dike and connection tunnel, were made. Relocations of highways about the Kensico reservoir were studied, the highways located and, in many instances, estimates made for contract quantities.

White Plains Division. Preliminary studies of a double aqueduct line between Kensico and Hill View reservoirs, this work being in part on the Kensico and Hill View divisions, were made during the early part of the year, but it was decided to adopt a single line. The location, size and grade of the Eastview filters were studied in detail, and the problem of procuring and transporting construction and filter materials was investigated. The aqueduct location between Kensico and the filters was decided in a general way, subject to minor changes which may be required after completion of sub-surface investigations.

Hill View Division. Detailed studies and estimates of location and type of construction of Bryn Mawr siphon have resulted in a decision in favor of a steel pipe siphon, instead of pressure tunnel. Studies were made of various lines for cut-and-cover and tunnel from the south end of Bryn Mawr siphon to Hill View reservoir, and a tentative conclusion to place this portion of the line in pressure tunnel was reached at the end of the year. A field examination was made of all construction materials in the vicinity of Hill View reservoir.

LONG ISLAND DEPARTMENT

WALTER E. SPEAR, *Division Engineer*

ORGANIZATION

DIVISIONS AND EMPLOYEES

The provisional organization of the department was retained, with such changes as were required during the year, by reductions in force and by new work. During the winter and spring the number of men in the field was reduced upon the completion of the preliminary surveys and investigations. In May the Patchogue and Moriches divisions were abandoned and the force employed at Patchogue was transferred to the office of the Nassau division at Freeport. With this force were consolidated the men remaining in the Jamaica division after the transfer to Headquarters department in April of William W. Brush, formerly in charge at Jamaica, and four assistants.

The divisions of the Long Island department and the men in charge after the above reorganization were as follows:

ENGINEERS IN CHARGE OF DIVISIONS

DIVISION	OFFICE	ASSISTANT ENGINEER IN CHARGE
Nassau	Freeport	Francis S. Pecke
Babylon	Babylon	John L. Hildreth, Jr.
Executive	Babylon	Charles W. Tarr

The total force of the department in January, including those in the labor class and gage-keepers, was 76; this number decreased to a minimum of 52 in September, and rose again in December, upon the temporary transfer of real estate parties from other departments, to 75.

The second floor of "Halycon Hall," on Deer Park avenue, Babylon, was retained for the main office of the department and for the Babylon division. The rooms on the second floor of the Masonic Temple building at Patchogue were given up on May 31, and those on the third floor of the Bernard block, at 372 Fulton street, Jamaica, were abandoned July 22, 1908, on the expiration of the lease. The second floor of the Smith block, 68 Main street, Freeport, was leased on May 7, 1909, for occupancy by the Nassau division, which was created from the forces transferred there from the Jamaica and Patchogue offices.

SUMMARY OF YEAR'S WORK

The topographic surveys which had been carried on since November, 1906, in southern Long Island, from Brooklyn to Quogue and Riverhead, were completed and mapped early in the year, and the triangulation system on which the surveys in Suffolk county were based was thoroughly monumented in order to be of permanent value. The results of the surveys on Long Island from November, 1906, to June, 1908, including the triangulation, the stadia surveys, and the levels made in connection with these surveys and with the test-wells and ground-water observations, were all tabulated and placed in record form. The rainfall stations at Babylon, Centre Moriches and Lake Ronkonkoma were maintained, and the gaging of all important Suffolk county streams was continued at the stations established last year. The monthly observations of the ground-water level on representative wells in Suffolk county were kept up and all records tabulated.

At Patchogue and Brookhaven two deep stove-pipe wells were driven to supplement the results obtained from six others of the same type, sunk between Lindenhurst and Islip during the previous year for the purpose of exploring the deep water-bearing strata. Studies and estimates were made for collecting works, aqueducts and pumping stations, and a plan was worked out for the complete development of the readily available ground-water sources in Suffolk county. Subsequently maps, diagrams and statistics were prepared for presentation before the State Water Supply Commission, in connection with the application of The City of New York for the approval of this plan.

Following the submission of the Suffolk county plan, a final location of the proposed Suffolk county aqueduct from Ridgewood pumping station, Brooklyn borough, to Great River, in Suffolk county, a distance of about 40 miles, was made, and land surveys between Rockville Center and Great River were begun.

PRELIMINARY WORK

SURVEYS

The preliminary surveys of the department were completed and mapped in April; tabulations of the entire work, including the Suffolk county triangulation system, the levels and stadia surveys, were then collected, with maps, sketches and photographs showing the triangulation stations, the method of carrying on the stadia work, and other matters of interest, and all were bound together in one volume as a final record of the work.

In May the surveys for the final location of the Suffolk county aqueduct were begun in Queens, Nassau and Suffolk counties, and, on the completion of this work in September and October in the several divisions, the real estate surveys were started.

TRIANGULATION

Concrete monuments were set in Suffolk county to mark the primary triangulation stations and fix the more important secondary stations of the system established in 1907 for the control of the topographic surveys, as follows:

NUMBER OF CONCRETE TRIANGULATION MONUMENTS SET DURING 1908

DIVISION	PRIMARY STATION	SECONDARY STATION	TOTAL
Babylon.....	22	18	40*
Patchogue.....	17	9	26
Moriches.....	21	0	21

*This number includes 24 set in this division during 1907.

LEVELS

Additional levels were run in Queens, Nassau and Suffolk counties for the purpose of securing additional topography, for profiles on the final location of the aqueduct, and for the purpose of fixing elevations of test-wells and surface waters not determined during the previous year. The amount of work accomplished is shown below.

SUMMARY OF BENCH LEVELING

	NUMBER OF MILES OF LEVELS RUN				NUMBER OF BENCH-MARKS ESTABLISHED			
	1906	1907	1908	Total	1906	1907	1908	Total
Base line and Primary Circuits.....	165	100	0	265	109	68	15	192
Secondary Circuits								
Jamaica division.....	0	21	0	21	0	27	0	27
Nassau division.....	0	0	0	0	0	0	0	0
Babylon division.....	14	189	4	207	11	415	2	428
Patchogue division.....	42	248	13	303	39	296	28	363
Moriches division.....	7	352	38	397	10	341	39	390
Totals.....	63	810	55	928	60	1,079	69	1,208
Total Primary and Secondary Levels.....	228	910	55	1,193	169	1,147	84	1,400

Standard bench-marks and bolts were set at important points on the primary level circuits, where good bench-marks were not originally found. Six standard bench-marks were placed, and eight bolts were set.

STADIA SURVEYS

A small amount of topography was taken early in the year on the preliminary location of the aqueduct and about the margins of the salt water estuaries in southern Suffolk county, where guard-ponds or reservoirs were proposed. The field notes were plotted and all topography was mapped on the rectangular co-ordinate sheets previously laid out. Altogether, 162 of these maps were made, 26 inches by 40 inches, showing all surveys from Brooklyn to Quogue and Riverhead, on a scale of 200 feet to an inch.

With further study of the aqueduct lines in the field and the adoption of a final location, additional stadia surveys were made and the notes plotted on the original sheets. The total amount of work done is shown in the following table:

SUMMARY OF STADIA SURVEYS—LONG ISLAND

DIVISION	TOTAL LENGTH OF STADIA TRAVERSES IN MILES			TOTAL AREA COVERED BY THESE SURVEYS IN ACRES		
	1907	1908	Total	1907	1908	Total
Jamaica.....	28	0	28	2,740	0	2,740*
Nassau.....	12	34	46	4,032	229	4,261
Babylon.....	94	15	109	6,016	838	6,854
Patchogue.....	88	3	91	6,889	1,350	8,239
Moriches.....	74	6	80	4,409	2,700	7,109
Totals.....	296	58	354	24,086	5,117	29,203

*Including surveys in Bay Ridge and Staten Island for proposed pipe crossings at the Narrows.

AQUEDUCT LOCATION

A final location of the proposed Suffolk county aqueduct was made from the Ridgewood pumping station in the Borough of Brooklyn, through Queens and Nassau counties to Great River, in Suffolk county, a distance of nearly 40 miles. From Brooklyn to Millburn reservoir, just east of Rockville Centre, this line was located upon the right-of-way already acquired by The City of New York for the extension of the 72-inch steel pipe-line by the Department of Water Supply, Gas and Electricity. East of the Millburn reservoir a new location was made somewhat northerly from the existing Brooklyn conduits and supply ponds, and farther from

the south shore, in order to secure favorable grades to safeguard the collecting works in Suffolk county from the inflow of sea water. Alternative lines were run and comparative estimates of cost were made.

The total length of location made in Queens, Nassau and Suffolk counties, including the alternative lines, are given below :

AQUEDUCT LOCATION

DIVISION	TOTAL NUMBER OF MILES OF LOCATION INCLUDING ALTERNATIVE LINES	LENGTH OF FINAL LOCATION IN MILES
Jamaica.....	8.0	8.0
Nassau.....	24.3	16.2
Babylon.....	18.2	14.6
Totals.....	50.5	38.8

SUBSURFACE INVESTIGATIONS

Two deep wells were sunk in Suffolk county to explore the deep water-bearing strata, and the entire ground-water surface within the proposed watershed was surveyed and mapped.

CALIFORNIA STOVE-PIPE WELLS

Stove-pipe wells Nos. 7 and 8, at Patchogue and Brookhaven, respectively, were driven on the line of the proposed collecting works in connection with wells 1 to 6 in western Suffolk county, which were completed in 1907. In well No. 7, electrically welded casing, 12 inches in diameter, was sunk to a depth of 461 feet and proved in every way superior to the riveted casings hitherto used. Well No. 8, also 12 inches in diameter, but with riveted casing, reached a depth of 916 feet, when the casing failed, and the well was necessarily abandoned without reaching bed-rock. The evidence furnished by these two wells confirmed the conclusions based upon the borings of the previous year, that there were no important water-bearing strata in the cretaceous deposits below the yellow gravels, 100 to 150 feet in depth. The total amount of work accomplished is shown below :

SUMMARY OF WORK ON CALIFORNIA STOVE-PIPE WELLS

	1907	1908	TOTAL
Number of wells driven.....	6	2	8
Size of wells in inches.....	12-16	12	12-16
Total depth of wells in feet.....	2,420	1,377	3,797

GROUND-WATER SURVEYS

Monthly observations of ground-water levels were continued upon representative test-wells in southern Suffolk county, from Amityville to Riverhead, and the elevations and locations of those wells not determined during the previous year were fixed.

HYDROGRAPHIC WORK

Observations were continued at the rainfall and stream-gaging stations previously established in Suffolk county.

RAINFALL

But for the high rainfall of the first five months of the year, an unprecedentedly low precipitation would have occurred on Long Island in 1908; even with the large rainfall of the early months, the total was less than that of any recorded observation there for 27 years.

STREAM FLOW

In so far as permission could be secured to enter upon private property, the flow of all the larger streams in Suffolk county was measured continuously, and occasional observations were made on the smaller ones. Stations equipped in 1907 with recording-gages were operated during the year, with some interruptions occasioned by damage to the weirs and recording instruments.

STUDIES AND DESIGNS

A complete plan was worked out for the development of a ground-water supply of 250 million gallons per day in Suffolk county, by means of a continuous line of wells along the south shore, from Amityville to Quogue and in the Peconic valley, and for the transportation of this supply to Brooklyn borough in a gravity aqueduct of concrete masonry. The estimated cost of the complete project was \$47,173,000, including the collecting and transportation works on the three branch lines, which were proposed for the development of storage; the cost as far as Great River included in the first stage of construction, by which 70 million gallons per day would be delivered to Brooklyn borough, \$21,742,000; and the cost of a preliminary stage, by which 40 or 50 million gallons per day would be delivered through the conduits of the Ridgewood system, \$7,153,000.

Maps, diagrams and statistics were prepared later to accompany the application of August, 1908, to the State Water Supply Commission for the approval of the above plan.

PRESENT SOURCES OF SUPPLY FOR BROOKLYN BOROUGH

Preliminary to the preparation of the Suffolk county plan, the existing works supplying the Borough of Brooklyn in Kings, Queens and Nassau counties were studied in detail in order to learn the yield of these works and to take advantage of the experience there gained in the development of a ground-water supply, where conditions are similar to those found in Suffolk county. The yield of the Ridgewood watershed during the past ten years furnished the best evidence on which to base the estimates of yield of the Suffolk county gathering grounds, and the wells and infiltration galleries offered many suggestions for the design of the proposed works. These studies showed that the Ridgewood watershed and other small sources of supply for Brooklyn borough had been already developed to nearly their full capacity and the necessity for an early beginning of the proposed Suffolk county works became most apparent.

TRANSPORTATION WORKS

The elevation of the ground surface on the location proposed for the collecting works in Suffolk county readily permitted a continuous gravity aqueduct to be laid out from Brooklyn to the end of the south shore line at Quogue, a distance of over 70 miles. The preliminary estimates on this line and on that in the Peconic valley were based upon an aqueduct of concrete masonry, similar in type to the Catskill aqueduct. The estimates proved this masonry aqueduct to be much cheaper than steel force mains, both in first cost and in operation.

Studies for two pumping stations were made, one at Riverhead to lift the Peconic valley supply over the hill to the main south shore aqueduct at Quogue; the second at Ridgewood, or at the alternative location at Fresh creek, to pump the entire Suffolk county supply into the distribution system of Brooklyn.

PREPARATIONS FOR SUFFOLK COUNTY HEARINGS

In order to present The City's case properly before the State Water Supply Commission in the application for the approval of the Suffolk county plan, and to meet such objections as might be

raised during the hearings on this application, a number of plans and drawings were made. Photographs were taken in Nassau and Suffolk counties to bring before the State Water Supply Commission the salient features of the Suffolk county project and show them the grounds for the objections to the proposed plan.

Appended to this report are tables showing the status of contracts and agreements, leases entered into, tabulations of bids received on the various contracts, statistics of stream flow, real estate acquired and other matters.

Respectfully submitted,

J. WALDO SMITH,

Chief Engineer.

TABLE 1
STATUS OF CONTRACTS EXECUTED TO DECEMBER 31, 1908

CONTRACT NUMBER	DESCRIPTION OF WORK	LOCATION	CONTRACTOR	BIDS OPENED	AMOUNT OF CONTRACT	ENGINEER'S ESTIMATE	FINAL PAYMENT	DATE OF CONTRACT	WORK BEGUN	TIME FOR COMPLETION	DATE OF COMPLETION	PER CENT COMPLETED
3	ASHOKAN RESERVOIR Main dams	Near Brown's Station, Ulster county	MacArthur Bros. Co. and Winsten & Co.	Aug. 6, 1907	\$12,669,775.00	\$12,850,000.00	.....	Sep. 5, 1907	Sep. 30, 1907	84 mos.	.....	7
5	A portion of an intercepting sewer	City of Kingston, Ulster county	Haggerty Contracting Co.	Sep. 3, 1907	14,568.35	16,871.00	\$13,653.22	Sep. 19, 1907	Oct. 22, 1907	4 mos.	Jun. 12, 1908	100
1	CATSKILL AQUEDUCT Test borings in channel and along shores of Hudson river	Near New Hamburg, Dutchess county	American Diamond Rock Drill Company	Feb. 5, 1906	170,000.00	.....	.....	Mar. 1, 1906	Apr. 21, 1906	4 mos.	.....	.....
1st Modification	Test borings in channel and along shores of Hudson river	Near New Hamburg, Dutchess county	Phoenix Construction Co.	.....	25,000.00	.....	.....	Feb. 21, 1908	Apr. 15, 1908	11 mos.	.....	54
2	Portion of Catskill aqueduct in Peekskill division	Towns of Cortlandt, Westchester county and Philipstown, Putnam county	Thomas McNally Company	Mar. 18, 1907	4,126,423.00	4,721,000.00	.....	Apr. 10, 1907	Apr. 27, 1907	45 mos.	.....	13
4	Field office building for division and section engineers	Town of Cortlandt, Westchester county	Daniel Carpenter	Jul. 23, 1907	11,095.00	9,500.00	11,095.00	Apr. 12, 1907	Aug. 19, 1907	5 mos.	May 1, 1908	100
6	Division office building	High Falls, Town of Marbletown, Ulster county	John J. McLean	May 12, 1908	8,965.00	10,800.00	.....	Jun. 2, 1908	Jun. 18, 1908	7½ mos.	.....	67

TABLE 1 (Concluded)
STATUS OF CONTRACTS EXECUTED TO DECEMBER 31, 1908

CONTRACT NUMBER	DESCRIPTION OF WORK	LOCATION	CONTRACTOR	BIDS OPENED	AMOUNT OF CONTRACT	ENGINEER'S ESTIMATE	FINAL PAYMENT	DATE OF CONTRACT	WORK BEGUN	TIME FOR COMPLETION	DATE OF COMPLETION	PER CENT COMPLETED
11	Portion of Catskill aqueduct in Esopus division	Towns of Olive and Marbetown, Ulster county	Stewart, Kerbaugh-Shanley Company	Jul. 23, 1908	\$2,368,920.00	\$3,137,655.00	.....	Aug. 5, 1908	Aug. 10, 1908	48 mos.	.....	2 1/2
12	Portion of Catskill aqueduct in Esopus division	Towns of Marbletown and New Paltz, Ulster county	The T. A. Gillespie Company	Jun. 2, 1908	6,290,803.50	5,313,684.00	.....	Jun. 12, 1908	Jun. 26, 1908	54 mos.	.....	9
15	Portion of cut-and-cover aqueduct in Wallkill division	Near New Hurley, Ulster county	The Elmore & Hamilton Contracting Co.	Sep. 1, 1908	933,867.50	1,205,835.00	.....	Sep. 9, 1908	Sep. 18, 1908	44 mos.	.....	2
38	Borings south of Hill View reservoir	Boroughs of Bronx, Manhattan, and Brooklyn, New York City	The Snares & Triest Company	Nov. 17, 1908	105,678.00	191,145.00	.....	Dec. 1, 1908	Dec. 19, 1908	13 mos.	.....	.....
A	GENERAL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
B	Printing 1906 Annual report	.....	J. W. Pratt Company	Apr. 15, 1908	1,689.84	2,000.00	\$1,713.52	May 1, 1908	.....	.....	Jul. 31, 1908	100
	Furnishing supplies	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Class A	.....	Technical Supply Co.	Aug. 25, 1908	3,804.09	.....	.....	Sep. 16, 1908	.....	.....	.....	.....
	Class B	.....	J. W. Pratt Co.	Aug. 25, 1908	1,789.18	.....	.....	Sep. 16, 1908	.....	.....	.....	.....
	Class C	.....	Continental Playing Card Co.	Aug. 25, 1908	1,876.05	.....	.....	Sep. 14, 1908	.....	.....	.....	.....
	Class D	.....	Joseph N. Early	Aug. 25, 1908	3,710.51	.....	.....	Sep. 14, 1908	.....	.....	.....	.....

* TABLE 2

STATUS OF AGREEMENTS

NUM- BER OF AGREE- MENT	DESCRIPTION AND LOCATION	NUMBER OF BIDDERS	CONTRACTOR	PRICES PER DAY
KENSICO RESERVOIR AND CATSKILL AQUEDUCT				
38	Wash borings at Kensico dam and filter sites and along aqueduct in Westchester county	3	F. W. Miller	\$18.00 per rig
CATSKILL AQUEDUCT				
22	Core borings in and along Foundry brook, Putnam county	2	C. H. McCarthy	
1st modifi- cation 22	To permit payment for inclined holes and for casings left in holes		C. H. McCarthy	
2nd modifi- cation 22	For a 4-inch hole in Rondout valley		C. H. McCarthy	
3rd modifi- cation 22	Core borings in Orange county and Rondout valley		C. H. McCarthy	
37	Test shafts at Hudson river crossing in Dutchess and Orange counties	4	Cranford Co.	
40	Core borings along the aqueduct in Orange county	6	Geo. M. Lyon	
1st modifi- cation 40	For casings left in holes		Geo. M. Lyon	
43	Construction of test-sections of reinforced concrete pipe, near Hunter's brook, Westchester county	4	Naughton Co.	

* For agreements completed prior to January 1, 1908, see Table 2 of 1907 Report.

* TABLE 2

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EXECUTED TO DECEMBER 31, 1908

PRICES PER LINEAR FOOT UNLESS OTHERWISE STATED			DATE OF EXECUTION	DATE OF COMPLETION	Cost	REMARKS
KENSICO RESERVOIR AND CATSKILL AQUEDUCT						
			Apr. 6, 1907	Apr. 30, 1908	\$7,168.50	Awarded on day basis
CATSKILL AQUEDUCT						
\$6.25			Oct. 18, 1906	Mar. 31, 1908	27,581.69	
Inclined holes \$9.00	Reaming holes \$9.00	Casings left in holes \$0.50 to \$0.85	Jun. 28, 1907			For delay due to porosity tests, \$1.00 per hour
			Aug. 7, 1907			
In*Shawangunk Other core borings \$3.25	grit, \$6.00 Shot-drill borings \$5.75		Oct. 19, 1907			
			Feb. 23, 1907	Feb. 28, 1908	113,664.66	
Until bed-rock is reached: 0-100feet \$6.00 100-200feet \$6.50 200-300feet \$7.00 300-400 feet \$7.50 400-500 feet \$8.00 500-600 feet \$8.50 Below 600 feet \$8.00 Delay caused by making porosity tests, \$2.50 per hour			Apr. 15, 1907	Jan. 31, 1908	19,188.51	
For 2, 3, 4, 4½, 6, 8, and 10-inch casing left in place, \$0.11, \$0.18, \$0.30, \$0.35, \$0.45, \$0.70, and \$1.10 per foot, respectively.			Jul. 10, 1907			
			May 25, 1907	May 31, 1908	24,195.20	

* For agreements completed prior to January 1, 1908, see Table 2 of 1907 Report.

TABLE 2 (Continued)

STATUS OF AGREEMENTS

NUMBER OF AGREEMENT	DESCRIPTION AND LOCATION	NUMBER OF BIDDERS	CONTRACTOR	PRICES PER DAY
CATSKILL AQUEDUCT (Continued)				
45	Core borings along aqueduct in Moodna creek valley, Orange County	6	Frederick Rockefeller (Germantown Artesian Well Co.)	
54	Section office No. 3, in town of Philipstown, Putnam county	5	Madison Building Co.	
55	Section office No. 4, near Garrison, in town of Philipstown, Putnam county	3	Madison Building Co.	
56	Section office No. 5, near Cold Spring, in town of Phillipstown, Putnam county	4	Madison Building Co.	
59	Temporary field office building in Marbletown township, Ulster county	5	John J. Wilson	
1st modification 59	Change in specifications		John J. Wilson	
66	Core borings along aqueduct in Westchester county	7	Harry M. Ripley	
67	Core borings along aqueduct in Westchester county	7	Arthur L. Washburne	

TABLE 2 (Continued)

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EXECUTED TO DECEMBER 31, 1908

PRICES PER LINEAR FOOT UNLESS OTHERWISE STATED	DATE OF EXECUTION	DATE OF COMPLETION	COST	REMARKS
CATSKILL AQUEDUCT (Continued)				
Until bed-rock is reached: 0-100feet 100-200feet 200-300feet \$6.00 \$7.00 \$8.00 300-400 feet 400-500 feet \$9.00 \$10.00 500-600 feet Below 600 feet \$11.00 \$12.00 In bed rock: To depth of 600 feet—\$6.50 Below 600 feet—\$7.50 For placing old holes in condition to be worked—\$20.00 per day For 4½, 6, 8, and 10-inch casing left in place, \$0.48, \$0.80, \$1.15, and \$1.40 per foot, respectively.	Jun. 17, 1907	Feb. 29, 1908	\$16,520.10	Next lowest to successful bidder for Agreement No. 40.
	Aug. 13, 1907	Apr. 29, 1908	\$4,775.00	
	Aug. 13, 1907	Jun. 1, 1908	4,775.00	
	Sep. 9, 1907	Jul. 26, 1908	4,990.00	
	Oct. 9, 1907	Feb. 22, 1908	4,484.00	\$4,578 was price at which agreement was awarded
	Nov. 15, 1907			
0-150 feet 150-300 feet Below \$4.00 \$8.00 \$10.00 For deepening Pumping old holes water per below 150 feet hour \$10.00 \$4.00	Nov. 15, 1907	Jun. 23, 1908	6,499.60	
0-150 feet Below Cores 2½ 150 feet 0-400 feet to 5 inches Cores 2½ Cores less \$5.00 to 5 inches than 2½ \$8.00 \$5.00 Pumping water from holes 1st Over 200 hours 200 hours \$4.00 \$3.50 per hour per hour	Nov. 15, 1907	Aug. 31, 1908	14,884.80	Same bids were used in awarding Agreements 66 and 67

TABLE 2 (Concluded)

STATUS OF AGREEMENTS

NUMBER OF AGREEMENT	DESCRIPTION AND LOCATION	NUMBER OF BIDDERS	CONTRACTOR	PRICES PER DAY
CATSKILL AQUEDUCT (Continued)				
68	Wash borings, test-pits and soundings on the proposed line of Catskill aqueduct in Ulster and Orange counties	9	Louis H. DuBois	
70	Test-pits on the proposed line of Catskill aqueduct in Westchester county	5	Toney Richards	
71	Test-borings into rock along the proposed location of Catskill aqueduct in Westchester county	10	Wm. M. Quinby	
72	Rental of two 16-inch by 20-inch hoisting engines, two 100 H.P. boilers and various accessories in towns of Cornwall, Orange county and Fishkill, Dutchess county	1	J. S. Mundy	
73	Rental of a compressed-air and lighting plant with accessories for putting down test shafts, driving tunnels and making borings therefrom, beneath Hudson river on the line of Catskill aqueduct, town of Cornwall, Orange county	1	Ingersoll-Rand Company	
ALL TERRITORY NORTH OF HILL VIEW RESERVOIR				
44	Core borings in all territory being investigated by Board of Water Supply north of Hill View reservoir	2	Sprague & Henwood	
1st modification 44	Casings left in holes		Sprague & Henwood	

TABLE 2 (Concluded)

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EXECUTED TO DECEMBER 31, 1908

PRICES PER LINEAR FOOT, UNLESS OTHERWISE STATED			DATE OF EXECUTION	DATE OF COMPLETION	COST	REMARKS
CATSKILL AQUEDUCT (Continued)						
Laborer per day \$2.25	Foreman per day \$3.00	Dynamite per lb. \$0.20	May 1, 1908	Aug. 8, 1908	\$2,436.59	
Lumber per M ft. B. M. \$28.00	Posts each \$0.40	Foreman per day \$4.00 Dynamite per lb. \$0.40	Jun. 6, 1908			
Laborer per day \$1.75						
0-150 feet large cores \$3.20	0-150 feet large cores \$3.20	Pumping per hour \$1.40	Sep. 8, 1908			
0-400 feet small cores \$3.20						
\$956 per month			Dec. 7, 1908			Whenever rental amounts to \$11,472, the plant becomes the property of The City
\$3,700 per month			Nov. 19, 1908			The plant may be pur- chased by The City at any time for \$33,899.00 previous monthly pay- ments being considered as payments on account
ALL TERRITORY NORTH OF HILL VIEW RESERVOIR						
In water 10 feet deep and over 200 feet from shore, \$4.50			Apr. 18, 1907	Aug. 31, 1908	\$101,245.24	
Land In Shawangunk borings grit \$4.00 \$6.00						
Prices ranging from \$0.35 to \$1.10			Aug. 12, 1907			

TABLE 3

CANVASS OF BIDS OPENED MAY 12, 1908, FOR CONTRACT 6, FIELD OFFICE BUILDING FOR DIVISION AND SECTION ENGINEERS, ESOPUS DIVISION, TOWN OF MARBLETOWN, ULSTER COUNTY, NEW YORK

NAME OF BIDDER	Address	AMOUNT
*John J. McLean.....	654 East 160th Street, N. Y. City	\$3,965.00
John J. Wilson.....	High Falls, N. Y.....	10,783.00
W. J. Haskins.....	96 Liberty Street, N. Y. City.....	12,200.00
Springsted & Adamson.....	424 East 107th Street, N. Y. City.....	14,496.00

* Awarded Contract

Engineer's Estimate.....	\$10,800.00
Bond required.....	2,000.00
Time.....	6 months

ITEM	DESCRIPTION	UNIT
1	Construction shafts, in earth.....	Linear foot.....
2	Construction shafts, in rock.....	" ".....
3	Refilling construction shafts.....	" ".....
4	Waterway and drainage shafts in earth.....	" ".....
5	Rock excavation in waterway and drainage shafts.....	Cubic yard.....
6	Timbering in waterway and drainage shafts.....	M feet B. M.....
7	Maintenance and removal of shaft timbering.....	" ".....
8	Excavation of pressure tunnel.....	Cubic yard.....
9	Additional trimming in shafts and tunnel.....	Square yard.....
10	Furnishing structural steel roof support.....	Pound.....
11	Erecting structural steel roof support.....	" ".....
12	Temporary timbering.....	M feet B. M.....
13	Construction pumping plant.....	Lump sum.....
14	Pumping from shafts and pressure tunnel.....	Million foot gallons.....
15	Drainage channels for shafts and pressure tunnel.....	Linear foot shafts, t.....
16	Forms for lining waterway and drainage shafts.....	Linear foot of shaft.....
17	Forms for inner lining of drainage shaft.....	" ".....
18	Forms for lining of tunnel and drainage drift.....	Linear foot tunnels.....
19	Concrete masonry in shafts.....	Cubic yard.....
20	Concrete masonry in tunnel and drainage drift.....	" ".....
21	Excess concrete masonry in shafts, tunnel and drift.....	" ".....
22	Brick masonry in shafts and tunnel.....	" ".....
23	Dry packing in pressure tunnel.....	Square foot.....
24	Drainage interlining in drainage shaft.....	Pound.....
25	Castings and valves in drainage drift and shaft.....	" ".....
26	Bronze access door and frame.....	" ".....
27	Structural steel interlining in drift and tunnel.....	" ".....
28	Cutting channels for water-stops.....	Square foot.....
29	Lead-lined, 16-inch cast-iron pipe and specials.....	Linear foot.....
30	Drilling 1½-inch or smaller holes in rock.....	" ".....
31	Drilling 1½ to 2½-inch holes in rock.....	" ".....
32	2-inch or smaller wrought-iron pipe for grouting, etc.....	" ".....
33	Miscellaneous plant and equipment for grouting.....	Lump sum.....
34	High-pressure air-compressors for grouting.....	Compressor.....
35	Tank grouting machines.....	Machine.....
36	Grouting pads.....	Pad.....
37	Connecting grouting machines to grout pipes.....	Connection.....
38	Setting grouting pads.....	Setting.....
39	Sand for grout.....	Ton.....
40	Mixing and placing grout.....	Cubic yard.....
41	Hydrostatic tests of tunnel.....	Test.....
42	Earth excavation in open cut.....	Cubic yard.....
43	Refilling and embanking.....	" ".....
44	Excavating top-soil.....	" ".....
45	Surface dressing of earth.....	" ".....
46	Timber and lumber.....	M feet B. M.....
47	Rock excavation in open cut.....	Cubic yard.....
48	Concrete masonry.....	" ".....
49	Reinforced concrete not in tunnel.....	" ".....
50	Steel for reinforcing concrete.....	Pound.....
51	Miscellaneous cast iron, wrought iron and steel.....	" ".....
52	Portland cement.....	Barrel.....
53	Sulphate of alumina for waterproofing.....	Pound.....
54	Cast-iron pipes and special pipe castings.....	Ton.....
55	Ten-inch and smaller sluice-gates.....	Gate.....
56	Bronze pipe and miscellaneous bronze.....	Pound.....
57	Vitrified pipe.....	Linear foot.....
58	Dry rubble masonry and paving.....	Cubic yard.....
59	Surfacing permanent roads.....	" ".....
60	Reinforced concrete ladders.....	Linear foot.....
61	Moving "DuBois" house.....	Lump sum.....
62	Locker houses.....	House.....
63	Cleaning up.....	Lump sum.....
Totals.....		

Time—51 months Bond required—\$750,000.00

Engineer's estimate—\$4,511,000.00

**Lump sum intended by bidder

*

	QUANTITY	S. PEARSON & SON, INC., LONG IS- LAND CITY, NEW YORK	BRADLEY CON- TRACTING COM- PANY, 329 WEST 68TH STREET, NEW YORK CITY	MACARTHUR BROTHERS COM- PANY, 11 PINE STREET, NEW YORK CITY	THE T. A. GIL- LESPIE COMPANY, 90 WEST STREET NEW YORK CITY
		PRICE	PRICE	PRICE	PRICE
	130	\$166.00	\$75.00	\$100.00	\$300.00
	950	118.00	125.00	260.00	300.00
	130	6.47	20.00	10.00	15.00
	105	68.00	100.00	75.00	300.00
	13,000	8.82	6.00	14.00	15.00
	425	103.00	60.00	100.00	80.00
	500	9.77	25.00	30.00	40.00
	253,000	5.25	6.00	6.70	8.00
	500	5.00	10.00	10.00	10.00
	1,220,000	.061	.04	.04	.05
	1,220,000	.004	.03	.04	.05
	125	70.00	55.00	75.00	100.00
	500,000	53,600.00	65,000.00	215,000.00	60,000.00
	25,750	.434	**50,000.00	.40	.20
nnel and drift.	1,220	2.19	4.00	2.50	2.00
	360	2.50	10.00	8.00	10.00
id drift.	23,470	2.00	10.00	8.00	10.00
	7,800	3.12	5.00	3.50	5.00
	100,000	4.75	8.00	10.00	10.00
	5,000	4.75	8.00	7.75	8.00
	200	3.00	3.00	3.00	3.00
	7,000	17.50	20.00	20.00	16.00
	17,500	2.00	3.00	3.50	3.00
	7,500	.20	.75	.35	.20
	8,500	.12	.10	.20	.10
	60,000	.60	.50	1.00	.75
	450	.074	.07	.10	.10
	415	.40	2.00	2.00	2.00
	2,500	18.75	40.00	15.00	40.00
	2,500	.35	1.00	.40	.60
	40,000	.45	1.00	.50	1.00
	10	.20	.25	.25	.50
	10	5,000.00	5,000.00	10,000.00	5,000.00
	10	2,186.00	1,000.00	300.00	300.00
	50	180.00	500.00	300.00	250.00
	7,000	69.00	25.00	150.00	100.00
	2,000	.83	2.00	.75	2.50
	3,700	.83	2.00	1.00	1.00
	5,000	1.56	2.00	1.50	2.00
	2	5.00	2.00	10.00	7.00
	12,500	5,000.00	20,000.00	5,000.00	5,000.00
	25,000	.50	1.00	.60	1.00
	26,000	.50	.75	.50	1.00
	31,000	.50	.62	.55	1.00
	50	.50	.50	.60	.50
	2,200	60.00	55.00	60.00	60.00
	3,500	2.50	2.50	1.25	3.00
	300	5.90	8.00	10.00	10.00
	55,000	7.00	10.00	18.00	15.00
	3,100	.04	.04	.05	.05
	190,000	.174	.05	.08	.10
	450,000	2.10	1.90	1.50	1.75
	20	.014	.04	.03	.02
	4	90.00	100.00	120.00	100.00
	8,000	100.00	50.00	100.00	60.00
	200	.62	.75	1.00	1.00
	250	.75	.50	1.50	1.50
	1,750	5.00	3.00	4.00	4.00
	85	2.50	1.50	3.00	4.00
		1.25	5.00	3.00	5.00
		1,200.00	1,500.00	3,000.00	2,500.00
		1,270.00	500.00	1,000.00	1,000.00
		5,000.00	10,000.00	3,000.00	15,000.00
		\$3,304,909.80	\$3,786,975.00	\$4,392,163.00	\$4,685,450.00

All bids rejected

CANVASS OF BIDS OPENED JUNE 2, 1908, FOR CONTRACT 12, RONDON

ITEM	DESCRIPTION	UNIT
1	Construction shaft, in earth	Linear foot
2	Construction shaft, in Shawangunk grit, Binnewater sandstone and High Falls shale	" "
3	Construction shaft in all kinds of rock not included in Item 2	" "
4	Refilling construction shafts	" "
5	Waterway and drainage shaft in earth	" "
6	Rock excavation in waterway and drainage shaft in Shawangunk grit, Binnewater sandstone and High Falls shale	Cubic yard
7	Rock excavation in waterway and drainage shaft in rock not included in Item 6	" "
8	Timbering in waterway and drainage shafts	M feet B. M.
9	Maintenance and removal of shaft timbering	" "
10	Excavation of pressure tunnel in Shawangunk grit, Binnewater sandstone and High Falls shale	Cubic yard
11	Excavation of pressure tunnel in rock not included in Item 10	" "
12	Furnishing structural steel roof support	Pound
13	Erecting structural steel roof support	" "
14	Construction pumping-plant	Lump sum
15	Pumping from shafts and pressure tunnel during construction	Million foot gallons
16	Drainage channels for shafts and pressure tunnel	Linear foot shaft, tunnel
17	Forms for lining of waterway shafts and outer lining of drainage shafts	Linear foot of shaft
18	Forms for inner lining of drainage shaft	" "
19	Forms for lining pressure tunnel and drainage drift	Linear foot of tunnel and
20	Concrete masonry in shafts	Cubic yard
21	Concrete masonry in pressure tunnel and drainage drift	" "
22	Drainage interlining in drainage shaft	Square foot
23	Furnishing and erecting steel castings and erecting special valves in drainage shaft and drift	Pound
24	Bronze access door and frame	" "
25	Structural steel interlining in drainage drift and pressure tunnel	" "
26	Cutting channels for water-stops	Square foot
27	Lead-lined 16-inch cast-iron flanged pipe and specials	Linear foot
28	Excavation of grade tunnel	Cubic yard
29	Permanent timbering in grade tunnel	M feet B. M.
30	Grade tunnel drainage	Linear foot of tunnel
31	Forms for masonry lining in grade tunnel	" "
32	Concrete masonry in grade tunnel	Cubic yard
33	Temporary timbering	M feet B. M.
34	Additional trimming in shafts, tunnels and drift	Square yard
35	Excess concrete masonry in shafts, tunnel and drift	Cubic yard
36	Brick masonry in shafts and tunnels	" "
37	Dry packing in tunnels	" "
38	Drilling 1½-inch or smaller holes in rock or masonry	Linear foot
39	Drilling 1½-inch to 2½-inch holes in rock or masonry	" "
40	Steel pipe for grouting, etc	" "
41	Miscellaneous plant and equipment for grouting	Lump sum
42	High-pressure air-compressors for grouting	Compressor
43	Tank grouting machines	Machine
44	Grouting pads	Pad
45	Making connections of tank grouting machines to grout pipes	Connection
46	Setting grouting pads	Setting
47	Sand for grout	Ton
48	Mixing and placing grout	Cubic yard
49	Hydrostatic tests of pressure tunnel	Test
50	Earth excavation in open cut	Cubic yard
51	Refilling and embanking	" "
52	Excavating top-soil	" "
53	Surface dressing of earth	" "
54	Timber and lumber	M feet B. M.
55	Rock excavation in open cut	Cubic yard
56	Concrete masonry in open cut	" "
57	Reinforced concrete not in tunnel	" "
58	Steel for reinforcing concrete	Pound
59	Miscellaneous cast iron, wrought iron and steel	" "
60	Portland cement	Barrel
61	Sulphate of alumina for waterproofing concrete, mortar or grout	Pound
62	Cast-iron pipes and special pipe castings	Ton
63	Ten-inch and smaller sluice-gates	Gate
64	Bronze pipe and miscellaneous bronze	Pound
65	Twelve-inch and smaller vitrified pipe	Linear foot
66	Dry rubble masonry and paving	Cubic yard
67	Surfacing permanent roads	" "
68	Reinforced concrete ladders	Linear foot
69	Locker houses	House
70	Cleaning up	Lump sum
Totals		

Time—54 months

Bond required—\$800,000

Engineer's Estimate—\$5,313,684

*Awarded co

UT PRESSURE TUNNEL AND ONE-HALF OF BONTICOU GRADE TUNNEL

QUANTITY	*THE T. A. GILLESPIE COMPANY, 90 WEST ST., NEW YORK CITY	BRADLEY CONTRACTING COMPANY, 329 W. 68th St., NEW YORK CITY	MACARTHUR BROTHERS COMPANY, 11 PINE ST., NEW YORK CITY	DEGNON CONTRACTING COMPANY, 60 WALL ST., NEW YORK CITY	S. PEARSON & SON, INC., LONG ISLAND CITY, NEW YORK
	PRICE	PRICE	PRICE	PRICE	PRICE
150	\$250.00	\$150.00	\$200.00	\$250.00	\$191.00
700	350.00	200.00	450.00	320.00	336.00
1,525	350.00	175.00	300.00	300.00	208.00
150	12.00	20.00	12.00	7.00	8.00
160	250.00	150.00	150.00	250.00	93.00
4,300	15.00	15.00	20.00	25.00	39.60
14,000	15.00	10.00	14.00	22.00	18.85
590	70.00	60.00	100.00	80.00	103.00
730	30.00	25.00	30.00	40.00	10.00
41,000	10.00	12.00	12.00	11.00	9.00
223,000	9.00	9.00	7.80	9.00	8.50
1,175,000	.04	.04	.05	.05	.07
1,175,000	.04	.06	.03	.02	.02
600,000	120,000.00	210,000.00	350,000.00	85,000.00	162,000.00
27,790	.30	.10	.60	.30	.50
1,750	2.50	2.00	2.50	2.00	2.50
485	8.00	10.00	8.00	9.00	3.75
23,690	8.00	10.00	8.00	9.00	3.75
11,500	4.00	5.00	4.80	4.00	3.75
110,000	10.00	9.00	9.00	9.00	10.68
23,500	8.00	10.00	7.45	9.00	10.68
	.30	.40	.35	.28	.35
7,500	.10	.15	.15	.12	.13
8,500	.80	.75	1.00	.60	.68
60,000	.07	.10	.10	.07	.09
450	2.00	5.00	2.00	2.00	2.00
550	30.00	40.00	30.00	30.00	21.50
37,000	6.00	9.00	4.65	8.00	8.28
80	70.00	60.00	75.00	80.00	70.00
3,340	1.50	5.00	2.00	1.25	2.50
3,340	3.50	10.00	4.00	4.00	3.75
9,900	7.00	10.00	7.00	8.00	8.68
150	70.00	60.00	60.00	100.00	70.00
600	8.00	10.00	10.00	5.00	5.75
6,000	3.00	3.00	3.00	3.00	3.00
200	15.00	25.00	20.00	16.00	20.00
8,500	3.00	3.00	3.25	3.50	2.50
2,500	.40	1.00	.40	.80	.75
2,500	.50	1.00	.50	1.10	.75
50,000	.40	.50	.25	.30	.25
	5,000.00	5,000.00	10,000.00	6,000.00	7,500.00
14	300.00	1,000.00	300.00	500.00	422.00
14	250.00	500.00	300.00	100.00	615.00
50	100.00	200.00	100.00	100.00	79.00
8,000	2.50	2.00	1.00	1.50	1.00
2,500	1.00	2.00	1.00	1.50	1.00
4,000	2.00	2.00	2.00	2.00	2.18
6,000	6.00	5.00	10.00	6.00	7.15
2	5,000.00	10,000.00	5,000.00	4,000.00	7,500.00
33,000	1.00	1.00	.60	1.00	.75
50,000	.75	.75	.60	.50	.75
16,000	.40	1.00	.55	.60	.75
14,000	.40	.50	.60	.50	.75
75	60.00	60.00	60.00	60.00	60.00
2,000	2.50	3.50	2.50	3.00	2.50
5,500	7.00	10.00	9.00	7.00	7.90
350	16.00	10.00	15.00	10.00	9.00
65,000	.05	.05	.05	.05	.04
4,200	.08	.10	.08	.10	.17
235,000	1.60	1.85	1.65	2.00	2.41
500,000	.02	.05	.02	.02	.03
21	100.00	110.00	110.00	90.00	90.00
5	60.00	110.00	100.00	70.00	100.00
11,000	1.00	.75	1.00	.60	.71
1,700	.50	.75	.50	.60	.75
600	3.50	4.00	4.00	4.00	5.00
2,200	3.50	3.00	3.00	3.00	2.50
115	3.50	5.00	3.00	4.00	5.00
7	1,000.00	1,000.00	1,000.00	1,000.00	1,450.00
	10,000.00	15,000.00	5,000.00	12,000.00	7,500.00
	\$6,290,803.80	\$6,414,335.00	\$6,419,173.00	\$6,579,410.00	\$6,787,111.25

tract]

TABLE

CANVASS OF BIDS OPENED JULY 23, 1908, FOR CONTRACT 11, A PORT

ITEM	DESCRIPTION	UNIT	QUANTITY	*STEWART-KERRAUGH-SHANLEY COMPANY 527 FIFTH AVENUE, NEW YORK CITY	THE B. & H. CONTRACT COMPANY 56 TWILY BUILDING ALBANY, N. Y.
				PRICE	PRICE
1	Removal of top-soil.....	Cubic yard	65,000	\$.57	
2	Open-cut excavation, Stations 95 to 110, Type B..	" "	20,000	.48	
3	" " " 110 to 122+25, " A..	" "	32,000	.48	
4	" " " 130 to 160, " A..	" "	61,000	.48	
5	" " " 160 to 210, " A..	" "	89,000	.55	
6	" " " 210 to 237, " B..	" "	27,000	.74	
7	" " " 237 to 256, " B..	" "	35,000	.93	
8	" " " 256 to 273, " B..	" "	30,000	.48	
9	" " " 273 to 314, " B..	" "	41,000	1.09	
10	" " " 314 to 325+50, " B..	" "	38,000	1.50	
11	" " " 325+50 to 346, " B..	" "	31,000	.48	
12	" " " 346 to 368, " B..	" "	38,000	.80	
13	" " " 402+70 to 407, " A..	" "	15,000	.93	
14	" " " 407 to 420, " A..	" "	15,000	.51	
15	" " " 420 to 478+50, " B..	" "	75,000	.52	
16	Refilling and embanking, Stations 95 to 110.....	" "	21,000	.37	
17	" " " 110 to 122+25.....	" "	22,000	.37	
18	" " " 130 to 160.....	" "	45,000	.37	
19	" " " 160 to 210.....	" "	76,000	.37	
20	" " " 210 to 237.....	" "	55,000	.53	
21	" " " 237 to 256.....	" "	19,000	.37	
22	" " " 256 to 273.....	" "	21,000	.37	
23	" " " 273 to 314.....	" "	75,000	.42	
24	" " " 314 to 325+50.....	" "	8,000	.42	
25	" " " 325+50 to 346.....	" "	32,000	.37	
26	" " " 346 to 368.....	" "	33,000	.37	
27	" " " 402+70 to 407.....	" "	3,000	.42	
28	" " " 407 to 420.....	" "	24,000	.42	
29	" " " 420 to 478+50.....	" "	77,000	.37	
30	Surface dressing and grassing.....	" "	42,000	.45	
31	Concrete masonry for aqueduct in open cut and on embankment.....	" "	165,000	5.42	
32	Concrete masonry for culverts, retaining-walls, etc.....	" "	10,000	5.42	
33	Dry rubble masonry and paving.....	" "	5,000	3.00	
34	Crushed stone and gravel.....	" "	1,000	2.00	
35	Sluice-gates.....	Gate	4	75.00	
36	Cast-iron pipes and special castings.....	Ton	8	100.00	
37	Vitrified pipe.....	Linear foot	1,000	1.50	
38	Timber and lumber.....	M feet B. M.	250	40.00	
39	Testing portions of aqueduct.....	Portion	12	1,000.00	
40	Testing portions of aqueduct exceeding 200 feet in length	Linear foot excess	2,600	5.00	
41	Excavation in tunnel.....	Cubic yard	40,000	4.10	
42	Additional trimming in tunnel.....	Square yard	400	5.00	
43	Permanent timbering in tunnel.....	M feet B. M.	100	50.00	
44	Temporary timbering in tunnel.....	" "	50	50.00	
45	Tunnel drainage.....	Linear foot of tunne	3,470	1.50	
46	Forms for masonry lining in tunnel.....	" "	3,470	4.00	
47	Concrete masonry in tunnel.....	Cubic yard	11,000	4.92	
48	Excess concrete masonry in tunnel.....	" "	700	2.50	
49	Brick masonry in tunnel.....	" "	200	15.00	
50	Dry packing.....	" "	2,000	2.50	
51	Drilling holes in rock or masonry.....	Linear foot	200	1.00	
52	Steel pipes for grouting.....	" "	1,000	.50	
53	Portland cement.....	Barrel	250,000	1.50	
54	Grout of Portland cement.....	Cubic yard	750	8.10	
55	Stone boundary walls.....	Linear foot	63,000	1.00	
56	Fences and guard-rails.....	" "	17,000	.25	
57	Steel for reinforcing concrete.....	Pound	100,000	.05	
58	Wrought iron, cast iron and steel.....	" "	6,000	.08	
59	Bronze.....	" "	2,500	.50	
60	Cleaning up.....	Lump sum	.....	18,000.00	7.
Totals.....				\$2,368,000.00	\$2,468,000.00

Time—48 months

Bond required—\$400,000

Engineer's estimate—\$3,137,855

6 ION OF THE CATSKILL AQUEDUCT IN THE ESOPUS DIVISION

	RINEHART & DENNIS COMPANY, WASHINGTON, D. C.	GORE ENGINEERING AND CONTRACTING COMPANY, 206 BROADWAY, NEW YORK CITY	THE JOHN J. HART COMPANY, 26 BEAVER STREET, NEW YORK CITY	MILLARD CONSTRUC- TION COMPANY, 704-709 PENNSYL- VANIA BUILDING, PHILADEL- PHIA, PA.	CRANFORD COMPANY, 190 MONTAGUE STREET, BROOKLYN, N. Y.	DAVID PEOPLES, 271 BROADWAY, NEW YORK CITY	W. BRADLEY CONTRACTING COMPANY, 329 WEST 68TH STREET, NEW YORK CITY
PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE
\$.32	\$.60	\$.60	\$.30	\$ 1.30	\$ 1.00	\$.60	\$ 1.00
.40	.60	.65	1.25	1.27	.93	.70	1.50
.40	.60	.65	.92	1.27	.93	.70	1.50
.50	.60	.65	.99	1.27	.97	.70	1.50
.65	.65	.90	1.14	1.27	1.41	.92	1.50
.60	.70	1.20	1.14	1.27	1.21	1.26	1.50
.65	.75	1.40	1.29	1.27	1.39	1.64	1.50
.42	.60	.75	.99	1.27	.93	.70	1.50
.65	.80	1.40	1.27	1.27	1.37	1.65	1.50
.70	.90	1.80	1.37	1.27	1.53	2.03	1.50
.40	.60	1.00	.99	1.27	.93	.70	1.50
.65	.80	1.20	1.32	1.27	1.25	1.39	1.50
.60	.90	1.60	1.32	1.27	1.57	2.00	1.50
.50	.60	.75	.99	1.27	.98	.80	1.50
.45	.60	.65	.99	1.27	.93	.70	1.50
.30	.40	.35	.53	.30	.32	.25	.75
.30	.40	.35	.53	.30	.32	.25	.75
.30	.40	.35	.53	.30	.32	.25	.75
.30	.40	.35	.53	.30	.32	.30	.75
.35	.40	.40	.53	.30	.71	.25	.75
.30	.40	.35	.53	.30	.32	.25	.75
.30	.40	.35	.53	.30	.32	.25	.75
.35	.40	.35	.53	.30	.71	.45	.75
.30	.40	.40	.53	.30	.32	.20	.75
.30	.40	.35	.53	.30	.32	.25	.75
.30	.40	.40	.53	.30	.32	.50	.75
.35	.40	.40	.53	.30	.55	.25	.75
.30	.40	.35	.53	.30	.32	.35	.75
.40	.60	.50	.45	.50	.50	.50	1.00
6.25	6.00	5.00	4.64	5.80	7.39	4.90	9.00
6.25	6.00	5.00	7.50	10.00	7.50	8.00	9.00
3.25	4.00	3.00	2.50	3.00	3.00	3.00	4.00
1.60	2.00	2.00	2.25	2.50	2.00	2.50	3.00
80.00	200.00	150.00	120.00	300.00	500.00	125.00	500.00
80.00	100.00	80.00	120.00	100.00	100.00	100.00	100.00
.40	2.00	2.00	1.50	1.50	1.50	1.00	1.00
55.00	60.00	60.00	60.00	50.00	70.00	60.00	75.00
00.00	1,000.00	1,200.00	500.00	,000.00	3,000.00	1,500.00	1,000.00
1.50	2.00	2.00	5.00	8.00	5.00	2.00	5.00
3.75	4.75	5.60	4.97	6.20	7.50	7.00	7.00
2.00	5.00	5.00	2.88	6.00	5.00	6.00	10.00
60.00	60.00	75.00	60.00	60.00	80.00	60.00	100.00
55.00	100.00	85.00	67.50	50.00	80.00	60.00	75.00
1.00	2.00	2.00	1.50	1.50	2.00	1.00	4.00
2.00	3.00	4.00	4.50	4.50	10.00	4.00	5.00
6.50	7.00	6.50	8.00	6.00	6.50	9.00	10.00
2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
14.00	20.00	20.00	25.00	15.00	15.00	20.00	20.00
2.00	3.00	2.50	2.35	3.00	3.00	1.50	3.00
.40	1.00	1.00	1.05	.50	1.00	.50	1.00
.20	.20	.50	.55	.50	1.00	.25	.50
1.80	1.85	2.00	1.80	1.95	1.65	2.00	2.00
6.00	6.00	8.00	18.00	8.00	5.00	5.00	6.00
1.50	1.20	1.00	.90	.90	.90	1.30	2.00
.50	.35	.30	.45	.40	.30	.40	.50
.05	.08	.05	.08	.06	.04	.05	.05
.06	.08	.08	.13	.10	.05	100.00	.06
.60	.80	.50	.50	.50	.75	.75	.80
00.00	10,000.00	25,000.00	5,320.00	10,000.00	35,000.00	15,000.00	10,000.00
00.00	\$2,627,330.00	\$2,664,640.00	\$2,688,877.00	\$3,008,710.00	\$3,293,025.00	\$3,379,485.00	\$4,064,090.00

*Awarded contract

TABLE 7

CANVASS OF BIDS OPENED AUGUST 25, 1908, FOR CONTRACT B,
FOR FURNISHING AND DELIVERING SUPPLIES

NAME OF BIDDER	ADDRESS	AMOUNT
CLASS A—ENGINEERING SUPPLIES		
*Technical Supply Co.	46 E. 14th St.	\$3,804.09
Keuffel & Esser Co.	127 Fulton St.	4,092.57
E. Dietsgen & Co.	214-220 E. 23rd St.	4,417.89
Kelesch & Co.	138 Fulton St.	4,509.71
CLASS B—STATIONERY SUPPLIES		
*J. W. Pratt Co.	52 Duane St.	\$1,789.19
Tower Bros. Stationery Co.	23 W. 23rd St.	1,880.29
Jordan Stationery & Printing Co.	177 Pearl St.	2,102.66
Gerry & Murray	75 Broad St.	2,274.16
CLASS C—PRINTED FORMS		
*Continental Playing Card Co.	4077 Park Ave.	\$1,876.05
Tower Bros. Stationery Co.	23 W. 23rd St.	2,007.30
Martin B. Brown Co.	49 Park Place	2,222.45
J. W. Pratt Co.	52 Duane St.	2,438.50
William Bratter & Co.	2 Duane St.	2,738.80
Gerry & Murray	75 Broad St.	2,765.50
Jordan Stationery & Printing Co.	177 Pearl St.	2,766.10
Clarence S. Nathan	9-11 Fulton St.	3,283.15
CLASS D—HARDWARE		
*Joseph N. Early	127 Reade St.	\$3,710.51

*Awarded contract

Bond required, 35% of the total amount of contract

Time, to December 31, 1908

TABLE

CANVASS OF BIDS OPENED SEPTEMBER 1, 1908, FOR CONTRACT 15, A

ITEM	DESCRIPTION	UNIT	QUANTITY	REMINGTON & SHERMAN Co., 359 BROADWAY, NEW YORK CITY	*THE ELMORE & HAMILTON CONTRACT- ING Co., 56 TWIDDLE BUILDING, ALBANY, N. Y.	DAVID PEOPLES, 271 BROADWAY, NEW YORK CITY
				PRICE	PRICE	PRICE
1	Removal of top-soil.....	Cubic yard	25,000	\$.46	\$.39	\$.60
2	Open-cut excavation.....	" "	390,000	.49	.45	.50
3	Refilling and embanking.....	" "	300,000	.23	.25	.29
4	Surface dressing and grassing.....	" "	20,000	.40	.40	.50
5	Concrete masonry for aqueduct in open cut.....	" "	80,000	4.92	5.50	5.00
6	Concrete masonry for culverts, retaining-walls, etc.....	" "	2,500	8.00	5.50	6.10
7	Portland cement.....	Barrel	108,000	1.45	1.55	1.65
8	Dry rubble masonry and paving.....	Cubic yard	2,500	3.00	3.00	3.10
9	Crushed stone and gravel.....	" "	250	2.00	1.75	2.30
10	Surfacing permanent access road.....	" "	450	5.00	2.00	2.00
11	Surfacing macadam roads.....	" "	300	5.00	2.00	7.00
12	Sluice-gates.....	Gate	1	75.00	90.00	150.00
13	Cast-iron pipes and special castings.....	Ton	1	100.00	90.00	100.00
14	Vitrified pipe.....	Linear foot	2,000	1.50	.90	.95
15	Timber and lumber.....	M feet B. M.	100	40.00	50.00	60.00
16	Stone boundary walls.....	Linear foot	9,500	1.25	1.10	1.25
17	Fences and guard-rails.....	" "	2,000	.30	.30	.42
18	Steel for reinforcing concrete.....	Pound	120,000	.05	.04	.04
19	Wrought iron, cast iron and steel.....	" "	2,000	.06	.06	.10
20	Bronze.....	" "	1,000	.50	.48	.70
21	Testing portions of aqueduct.....	Portion	6	500.00	750.00	1,500.00
22	Testing portions of aqueduct exceeding 200 feet in length.....	Linear foot of excess	1,200	2.00	2.50	2.00
23	Moving "Birch" house.....	Lump sum	.....	1,000.00	500.00	2,460.00
24	Cleaning up.....	" "	.....	300.00	3,000.00	4,000.00
Totals.....				\$894,520.00	\$933,867.50	\$958,000.00

ITEM	DESCRIPTION	UNIT	QUANTITY	MASON & HANGER CO. AND DAVID LUPTON'S SON'S Co., 50 CHURCH STREET, NEW YORK CITY	STEWART- KERBAUGH- SHANLEY Co., 527 FIFTH AVENUE, NEW YORK CITY	BUR- ROUGHS HOF- MAN, 1170 WAY NEW YORK
				PRICE	PRICE	PRICE
1	Removal of top-soil.....	Cubic yard	25,000	\$.40	\$.60	
2	Open-cut excavation.....	" "	390,000	.60	.60	
3	Refilling and embanking.....	" "	300,000	.30	.35	
4	Surface dressing and grassing.....	" "	20,000	.80	.50	
5	Concrete masonry for aqueduct in open cut.....	" "	80,000	5.75	6.00	
6	Concrete masonry for culverts, retaining-walls, etc.....	" "	2,500	5.75	6.50	
7	Portland cement.....	Barrel	108,000	1.60	1.50	
8	Dry rubble masonry and paving.....	Cubic yard	2,500	5.50	3.00	
9	Crushed stone and gravel.....	" "	250	2.00	2.50	
10	Surfacing permanent access road.....	" "	450	1.75	4.00	
11	Surfacing macadam roads.....	" "	300	2.00	6.00	
12	Sluice-gates.....	Gate	1	100.00	75.00	
13	Cast-iron pipes and special castings.....	Ton	1	100.00	100.00	
14	Vitrified pipe.....	Linear foot	2,000	1.50	1.50	
15	Timber and lumber.....	M feet B. M.	100	60.00	60.00	
16	Stone boundary walls.....	Linear foot	9,500	1.10	1.50	
17	Fences and guard-rails.....	" "	2,000	.30	.30	
18	Steel for reinforcing concrete.....	Pound	120,000	.05	.05	
19	Wrought iron, cast iron and steel.....	" "	2,000	.06	.10	
20	Bronze.....	" "	1,000	.60	.50	
21	Testing portions of aqueduct.....	Portion	6	1,000.00	800.00	
22	Testing portions of aqueduct exceeding 200 feet in length.....	Linear foot of excess	1,200	5.00	4.00	
23	Moving "Birch" house.....	Lump sum	.....	500.00	1,000.00	
24	Cleaning up.....	" "	.....	5,000.00	5,000.00	
Totals.....				\$1,057,282.50	\$1,080,300.00	\$1,080,300.00

Time—44 months

Bond required—\$225,000.00

Engineer's estimate—\$1,205,835.00

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PORTION OF THE CATSKILL AQUEDUCT IN THE WALLKILL DIVISION

147

HOFFMAN ENGINEERING & CONTRACTING Co., 1116 PENN BUILDING, PHILADEL- PHIA, PA.	ROBERT C. STORRIE, PHILADEL- PHIA, PA.	GOBE ENGI- NEERING & CONTRAC- TING Co., 206 BROADWAY, NEW YORK CITY	ARTHUR McMULLEN 13-21 PARK ROW, NEW YORK CITY	BELLEW & MERRITT Co., TUCKAHOE, N. Y.	RINEHART & DENNIS Co., COLORADO BUILDING, WASHINGTON, D. C.	RICHARD E. HENINGHAM, 1 MADISON AVENUE, NEW YORK CITY	THE PHOENIX CONSTRUC- TION Co., 41 PARK ROW, NEW YORK CITY
PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE
\$.50	\$.30	\$.50	\$.40	\$.75	\$.60	\$.44	\$.46
.59	.60	.52	.37	.47	.55	.62	.67
.30	.25	.35	.25	.34	.35	.33	.32
.40	.45	.45	.50	1.00	.60	.42	.52
4.94	5.00	5.00	6.25	5.40	5.50	5.70	5.35
4.94	7.00	5.00	7.00	6.00	6.00	8.05	6.50
1.50	1.60	1.60	1.60	1.75	1.60	1.50	1.67
3.25	3.00	3.00	3.50	5.00	5.00	3.14	3.10
2.50	4.00	2.00	2.50	3.00	2.00	2.70	2.30
4.50	3.00	2.50	2.50	4.00	2.00	2.40	3.78
3.50	4.00	3.00	4.00	4.00	3.00	3.60	3.78
150.00	200.00	150.00	350.00	300.00	100.00	96.00	115.00
100.00	100.00	100.00	100.00	90.00	100.00	100.00	69.00
1.00	1.75	1.50	1.50	1.50	2.00	2.00	.66
50.00	50.00	50.00	50.00	50.00	60.00	60.00	61.00
1.50	1.25	1.00	1.50	1.00	2.50	1.20	.97
.25	.40	.30	.40	.35	.35	.40	.37
.05	.05	.05	.05	.05	.06	.05	.03
.04	.10	.08	.06	.08	.06	.06	.06
.35	.75	.50	.60	.60	.60	.50	.46
800.00	1,000.00	1,200.00	1,000.00	1,500.00	1,000.00	750.00	1,200.00
4.00	2.50	2.00	4.00	7.50	2.00	4.00	2.30
1,000.00	1,000.00	1,500.00	1,000.00	500.00	1,000.00	500.00	575.00
5,000.00	4,000.00	10,000.00	6,000.00	5,000.00	5,000.00	5,000.00	3,750.00
\$966,005.00	\$969,275.00	\$970,735.00	\$989,320.00	\$1,025,150.00	\$1,046,070.00	\$1,052,826.00	\$1,053,594.00

LER HERS Co., BROAD- NEW CITY	THE CLEMENT- KING Co., LAND TITLE BUILDING, PHILADEL- PHIA, PA.	MILLARD CONSTRUC- TION Co., PHILADEL- PHIA AND NEW YORK CITY	THE JOHN J. HART Co., 26 BEAVER STREET, NEW YORK CITY	BOWMAN BROTHERS, McKEESPORT, PA.	THE J. CONNELLY CONSTRUC- TION Co., BALTIMORE, MD.	BUNTING BULL Co., FLUSHING, N. Y.	S. PEARSON & SON, INC., LONG ISLAND CITY, N. Y.
PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	PRICE
\$.30	\$.45	\$1.00	\$1.00	\$.75	\$.60	\$.60	\$.30
.74	.60	.66	.77	.70	1.14	1.10	1.00
.25	.45	.30	.40	.30	.30	.45	.49
1.50	.50	.50	.60	.25	.35	.50	.70
5.50	5.25	6.00	5.50	6.50	6.00	6.40	8.20
6.00	6.00	10.00	7.00	8.00	8.00	6.40	8.20
1.60	1.75	1.80	1.70	1.60	1.75	1.90	2.42
5.00	6.00	3.00	2.50	4.00	3.00	3.50	5.00
2.00	2.50	3.00	2.00	3.00	3.50	3.50	3.50
3.00	1.00	3.50	2.00	3.00	4.00	3.50	3.00
3.33	4.00	3.50	2.50	3.00	4.00	4.00	5.00
100.00	150.00	100.00	100.00	100.00	100.00	120.00	50.00
200.00	100.00	100.00	100.00	120.00	100.00	120.00	100.00
1.00	1.50	1.25	1.00	1.00	1.50	2.00	1.00
50.00	60.00	60.00	60.00	60.00	60.00	55.00	60.00
1.60	2.00	1.00	1.25	1.50	1.25	1.20	2.25
1.00	.40	.40	.50	1.00	.50	.45	.50
.03	.06	.05	.04	.05	.06	.05	.04
.05	.06	.10	.06	.06	.06	.10	.15
.50	.60	.60	.50	.50	.75	.80	.75
500.00	1,000.00	1,000.00	500.00	1,000.00	1,000.00	1,400.00	5,000.00
5.00	5.00	5.00	3.00	5.00	4.00	7.00	12.00
100.00	500.00	1,500.00	1,000.00	1,000.00	750.00	1,500.00	1,500.00
100.00	10,000.00	7,000.00	5,000.00	5,000.00	10,000.00	15,000.00	5,000.00
\$949.00	\$1,090,995.00	\$1,138,975.00	\$1,145,895.00	\$1,161,640.00	\$1,308,670.00	\$1,396,940.00	\$1,600,460.00

ded contract

TABLE

CANVASS OF BIDS OPENED NOVEMBER 17, 1908, FOR CONTRACT 38

ITEM	DESCRIPTION	UNIT	QUANTITY	*THE SNARE & TRIEST COMPANY, 143 LIBERTY STREET, NEW YORK CITY	HEAD MAG CON CO 13-21 NEW
				PRICE	
LAND BORINGS					
1	Sinking casing for 1-inch cores.....	Linear foot	5,000	\$1.80	
2	Sinking casing for 1½-inch cores.....	" "	1,800	1.95	
3	Sinking casing for 3-inch cores.....	" "	200	2.10	
4	Drilling 1-inch cores where rock penetration does not exceed 50 feet.....	" "	1,400	4.12	
5	Drilling 1-inch cores where rock penetration exceeds 50 feet.....	" "	300	3.75	
6	Drilling 1½-inch cores where rock penetration exceeds 50 feet.....	" "	9,400	4.20	
7	Drilling 3-inch cores where rock penetration exceeds 50 feet.....	" "	300	4.90	
8	Transporting drilling machines.....	Day	20	30.00	
9	Pumping holes.....	Hour	200	4.50	
RIVER BORINGS					
10	Sinking casing for 1-inch cores	Linear foot	4,000	4.20	
11	Sinking casing for 1½-inch cores.....	" "	300	4.35	
12	Sinking casing for 3-inch cores.....	" "	200	4.50	
13	Drilling 1-inch cores where rock penetration does not exceed 50 feet.....	" "	700	9.60	
14	Drilling 1-inch cores where rock penetration exceeds 50 feet.....	" "	1,150	9.10	
15	Drilling 1½-inch cores where rock penetration exceeds 50 feet.....	" "	300	9.60	
16	Drilling 3-inch cores where rock penetration exceeds 50 feet.....	" "	150	9.90	
GENERAL ITEMS					
17	6-inch or larger casing left in place.....	" "	300	3.00	
18	4½-inch to 5½-inch casing left in place.....	" "	300	2.00	
19	3-inch to 4-inch casing left in place.....	" "	500	1.50	
20	2-inch to 2½-inch casing left in place.....	" "	500	1.20	
Totals.....				\$105,678.00	\$

*Awarded contract

Time—5,800 linear feet of land borings within 6 months; expires by limitation December 31, 1910

Bond required—\$50,000

Engineer's estimate—\$191,145

9

8, FOR MAKING BORINGS SOUTH OF HILL VIEW RESERVOIR

KEY SEWER MACHINE AND CONSTRUCTION COMPANY, PARK ROW, NEW YORK CITY	GEO. H. ST. CLAIR, VIRGINIA, (ST. LOUIS CO.), MINN.	CHAS. H. STRONG SON & COMPANY, CLEVELAND, O. THE CYCLONE DRILL CO., ORVILLE, O.	THE PHOENIX CONSTRUCTION COMPANY, 41 PARK ROW, NEW YORK CITY	THE UNITED ENGINEERING & CONTRACTING COMPANY, 32 E. 33rd ST., NEW YORK CITY	SULLIVAN MACHINERY COMPANY, CHICAGO, ILL. N. Y. OFFICE, 42 BROADWAY	AVERAGE OF BID PRICES
PRICE	PRICE	PRICE	PRICE	PRICE	PRICE	
\$2.95	\$3.00	\$1.75	\$2.84	\$3.36	\$4.50	\$2.89
2.98	3.00	1.85	4.25	3.74	5.00	3.25
3.00	3.50	2.95	5.35	5.93	6.00	4.12
2.95	6.00	3.50	7.80	6.21	4.50	5.01
2.95	6.00	4.00	6.80	7.61	4.50	5.09
2.98	6.00	4.00	7.30	5.23	5.00	4.96
3.00	8.00	6.00	9.10	8.80	6.00	6.54
15.00	14.50	30.00	45.00	50.00	20.00	29.21
2.00	1.00	4.00	6.00	5.00	5.00	3.93
7.79	4.00	11.00	9.00	15.35	20.00	10.19
9.87	4.00	11.50	9.00	15.62	21.50	10.83
10.75	5.00	12.50	9.00	18.12	23.50	11.91
7.79	7.00	12.50	17.70	18.12	20.00	13.24
7.79	7.00	14.50	13.20	22.60	20.00	13.46
9.87	8.00	14.50	13.60	23.50	21.50	14.37
10.75	9.00	16.50	16.05	29.30	23.50	16.43
.94	1.39	1.50	1.25	4.25	1.65	2.00
.75	1.00	1.00	.65	1.75	1.35	1.21
.53	.60	.75	.55	.90	.85	.81
.40	.30	.60	.40	.50	.60	.57
111,569.00	\$126,657.00	\$143,195.00	\$184,932.50	\$211,826.00	\$230,000.00	

CANVASS OF BIDS OPENED DECE

ITEM	DESCRIPTION	UNIT	QUANTITY
1	Construction shaft in earth.....	Linear foot	2
2	Construction shaft in rock.....	" "	2
3	Refilling construction shaft.....	" "	2
4	Waterway and drainage shafts in earth.....	" "	2
5	Rock excavation in waterway and drainage shafts.....	Cubic yard	9.2
6	Excavation of pressure tunnel and drainage drift.....	" "	125.0
7	Additional trimming in shafts, tunnel and drift.....	Square yard	3
8	Furnishing structural steel roof support.....	Pound	600.0
9	Erecting structural steel roof support.....	" "	600.0
10	Temporary timbering.....	M feet B. M.	200.0
11	Pumping from shafts and pressure tunnel during construction.....	Million foot gallons	200.0
12	Drainage channels for shafts and pressure tunnel.....	Linear foot shaft, tunnel and drift	12.8
13	Forms for lining of waterway shaft and outer lining of drainage shaft.....	Linear foot of shaft	3
14	Forms for inner lining of drainage shaft.....	" "	3
15	Forms for lining of tunnel and drainage drift.....	Linear foot of tunnel and drift	11.4
16	Concrete masonry in shafts.....	Cubic yard	5.4
17	Concrete masonry in tunnel and drainage drift.....	" "	49.4
18	Excess concrete masonry in shafts, tunnel and drift.....	" "	2.4
19	Brick masonry in shafts and tunnel.....	" "	3.4
20	Dry packing in pressure tunnel.....	" "	17.4
21	Drainage interlining in drainage shaft.....	Square foot	17.4
22	Furnishing and erecting steel castings and erecting special valves in drainage drift and shaft.....	Pound	7.0
23	Bronze access door and frame.....	" "	8.0
24	Structural steel interlining in drainage drift and tunnel.....	" "	60.0
25	Cutting channels for water-stops.....	Square foot	3.0
26	Lead lined, 16-inch cast-iron pipe and specials.....	Linear foot	1.0
27	Drilling 1½-inch or smaller holes in rock or masonry.....	" "	1.0
28	Drilling 1½-inch to 2½-inch holes in rock or masonry.....	" "	1.0
29	Steel pipe for grouting, etc.....	" "	20.0
30	Miscellaneous plant and equipment for grouting.....	Lump sum	....
31	High-pressure air-compressors for grouting.....	Compressor	....
32	Tank grouting machines.....	Machine	....
33	Grouting pads.....	Pad	....
34	Making connections of tank grouting machines to grout pipes.....	Connection	3.0
35	Setting grouting pads.....	Setting	1.0
36	Sand for grout.....	Ton	1.0
37	Mixing and placing grout.....	Cubic yard	2.0
38	Earth excavation in open cut.....	" "	8.0
39	Refilling and embanking.....	" "	14.0
40	Excavating top-soil.....	" "	18.0
41	Surface dressing of earth.....	" "	17.0
42	Timber and lumber.....	M feet B. M.	2.0
43	Rock excavation in open cut.....	Cubic yard	2.0
44	Concrete masonry in open cut.....	" "	2.0
45	Reinforced concrete not in tunnel.....	" "	2.0
46	Steel for reinforcing concrete.....	Pound	22.0
47	Miscellaneous cast iron, wrought iron and steel.....	" "	3.0
48	Portland cement.....	Barrel	101.0
49	Sulphate of alumina for waterproofing concrete, mortar or grout.....	Pound	125.0
50	Cast-iron pipe and special pipe castings.....	Ton	....
51	Ten-inch and smaller sluice-gates.....	Gate	....
52	Bronze pipe and miscellaneous bronze.....	Pound	6.0
53	Vitrified pipe.....	Linear foot	....
54	Dry rubble masonry and paving.....	Cubic yard	....
55	Rubble masonry and paving in mortar.....	" "	....
56	Surfacing permanent roads.....	" "	1.0
57	Reinforced concrete ladders.....	Linear foot	....
58	Moving "DuBois" house.....	Lump sum	....
59	Locker houses.....	House	....
60	Cleaning up.....	Lump sum	....
	Totals.....	.....	....

Time—47 months

Bond required—\$450,000

ER 1, 14

MOOTH & F.
LIMITED
PITTSBURGH,

COMBINED
CONTRACT

PRICE

\$204
204
14
214
8
1
1
1
3
2,50
60
25
7
8
8
12
5.00
1.50
5.00
\$1,718.38

CANVASS OF BIDS OPENED DECEMBER

ITEM	DESCRIPTION	UNIT	QUANTITY
1	Construction shafts in earth.....	Linear foot	50
2	Construction shafts in rock.....	" "	660
3	Refilling construction shafts.....	" "	50
4	Waterway shaft in earth.....	" "	50
5	Rock excavation in waterway shaft.....	Cubic yard	3,700
6	Excavation of pressure tunnel.....	" "	127,500
7	Additional trimming in shafts and tunnel.....	Square yard	300
8	Furnishing structural steel roof support.....	Pound	615,000
9	Erecting structural steel roof support.....	" "	615,000
10	Temporary timbering.....	M feet B. M.	65
11	Pumping from shafts and pressure tunnel during construction	Million foot gallons	200,000
12	Drainage channels for shafts and pressure tunnel.....	Linear foot shaft and tunnel	12,900
13	Forms for lining of waterway shaft.....	Linear foot of shaft	395
14	Forms for lining of tunnel.....	Linear foot of tunnel	11,800
15	Concrete masonry in shafts.....	Cubic yard	2,800
16	Concrete masonry in tunnel.....	" "	50,500
17	Excess concrete masonry in shafts and tunnel.....	" "	2,500
18	Brick masonry in shafts and tunnel.....	" "	200
19	Dry packing in pressure tunnel.....	" "	3,500
20	Drilling 1½-inch or smaller holes in rock or masonry.....	Linear foot	1,250
21	Drilling 1½-inch to 2½-inch holes in rock or masonry.....	" "	1,250
22	Steel pipe for grouting, etc.....	" "	20,000
23	Miscellaneous plant and equipment for grouting.....	Lump sum	.....
24	High-pressure air-compressors for grouting.....	Compressor	5
25	Tank grouting machines.....	Machine	5
26	Grouting pads.....	Pad	25
27	Making connections of tank grouting machines to grout pipes.....	Connection	3,500
28	Setting grouting pads.....	Setting	1,000
29	Sand for grout.....	Ton	1,850
30	Mixing and placing grout.....	Cubic yard	2,600
31	Excavation in open cut.....	" "	3,600
32	Refilling and embanking.....	" "	11,000
33	Excavating top-soil.....	" "	8,700
34	Surface dressing of earth.....	" "	13,500
35	Timber and lumber.....	M feet B. M.	5
36	Concrete masonry in open cut.....	Cubic yard	1,450
37	Reinforced concrete not in tunnel.....	" "	125
38	Steel for reinforcing concrete.....	Pound	22,000
39	Miscellaneous cast iron, wrought iron and steel.....	" "	200
40	Portland cement.....	Barrel	98,000
41	Sulphate of alumina for waterproofing concrete, mortar or grout.....	Pound	121,000
42	Cast-iron pipe and special pipe castings.....	Ton	10
43	Ten-inch and smaller sluice-gates.....	Gate	1
44	Bronze pipe and miscellaneous bronze.....	Pound	1,300
45	Vitrified pipe.....	Linear foot	100
46	Dry rubble masonry and paving.....	Cubic yard	50
47	Rubble masonry and paving in mortar.....	" "	50
48	Surfacing permanent roads.....	" "	275
49	Reinforced concrete ladders.....	Linear foot	25
50	Locker houses.....	House	3
51	Cleaning up.....	Lump sum	.....
	Totals.....		

Time—47 months

Bond—\$450,000

*All bids rejected

1, 1908

OTH & FL
LIMITED
ITSBURG,

MBINED W
ONTRACT

PRICE

\$200.
200.
10.
210.
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80.
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12.
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600
250
70.
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80
6
10
1
80
125
1
4
5
2
3
1,500
5,000
\$1,647,074

TABLE 12

STATUS OF REAL ESTATE ACQUIRED, BEING ACQUIRED, AND TO BE ACQUIRED IN THE DEVELOPMENT OF CATSKILL
SUPPLY AS OF DECEMBER 31, 1908

DEPARTMENT	RESERVOIR	NORTHERN AQUEDUCT			SOUTHERN AQUEDUCT			TOTALS
		ASHOKAN RESERVOIR	CATSKILL AQUEDUCT	HILL VIEW RESERVOIR	KENSICO RESERVOIR	CATSKILL AQUEDUCT		
Number of sections approved by Board of Water Supply	*14		8	2	10	2		36
Number of parcels included in above sections	716		410	119	788	96		2,129
Additional parcels to be acquired, not shown on filed maps . . . . .	.....		5	.....	1	3		9
Combined area, in acres, of above parcels (fee acquirement)	12,320.03		1,582.54	163.38	3,183.52	314.07		17,563.54
Combined area, in acres, of above parcels (temporary easement acquirement) . . . . .	.....		29.63	.....	.....	2.59		32.22
Combined area, in acres, of above parcels (permanent easement acquirement) . . . . .	.....		4.06	.....	.....	8.09		12.15
Number of Appraisal Commissions appointed	9		5	2	10	1		27
Area, in acres, to which title is vested in The City .	8,281.97		1,166.40	163.38	940.36	.....		10,552.11
Area, in acres, of real estate approved by Board of Water Supply, to which title is not yet vested in The City	4,038.06		449.83	.....	2,243.16	324.75		7,055.80
Area, in acres, on maps to be approved (in course of preparation)	2,901.28		.....	.....	.....	.....		2,901.28
Total area, in acres, necessary (approximate)	15,221.00		1,616.00	163.00	3,183.00	960.00		21,113.00

*This total is exclusive of the Highway section (containing 93 parcels), which was approved by the Board of Water Supply on June 9, 1908; and Railroad sections 1 and 2, which were referred to a special committee by the Board of Estimate and Apportionment

TABLE 13
STATUS OF REAL ESTATE TAKING MAPS PREPARED TO DECEMBER 31, 1908

DEPARTMENT STRUCTURE	SECTION	NUMBER OF PARCELS	ACRES TO BE ACQUIRED			APPROVED BY BOARD OF WATER SUPPLY	ADOPTED BY BOARD OF ESTIMATE AND APPORTIONMENT	COMMISSIONERS OF APPRAISAL AND APPOINTED	TITLE VESTED IN CITY
			TEMPORARY EASEMENT	PERMANENT EASEMENT	FEE				
RESERVOIR Ashokan Res.	1	41	...	...	1,085.508	Jan. 9, 1907	Jan. 18, 1907	Apr. 20, 1907	May 3, 1907
	2	40	...	...	634.882	Jan. 9, 1907	Jan. 18, 1907	Apr. 20, 1907	May 7, 1907
	3	58	...	...	1,523.365	Jan. 30, 1907	Feb. 8, 1907	Apr. 20, 1907	May 10, 1907
	4	41	...	...	741.944	Feb. 13, 1907	Mar. 1, 1907	Apr. 20, 1907	May 4, 1907
	5	42	...	...	1,387.071	Feb. 13, 1907	Mar. 1, 1907	May 18, 1907	Jun. 7, 1907
	6	47	...	...	1,169.879	Apr. 24, 1907	May 3, 1907	Jun. 29, 1907	Jul. 23, 1907
	7	44	...	...	862.830	May 6, 1907	May 10, 1907	Jun. 29, 1907	Jul. 23, 1907
	8	65	...	...	399.097	Jun. 26, 1907	Jul. 8, 1907	Sep. 21, 1907	Oct. 5, 1907
	9	59	...	...	477.392	Jun. 26, 1907	Jul. 8, 1907	Sep. 21, 1907	Oct. 5, 1907
	10	55	...	...	845.847	Oct. 16, 1907	Oct. 25, 1907	...	...
	11	53	...	...	662.611	Oct. 16, 1907	Oct. 25, 1907	...	...
	12	65	...	...	462.574	Feb. 6, 1908	Feb. 28, 1908	...	...
	13	53	...	...	1,332.664	Feb. 6, 1908	Feb. 28, 1908	...	...
	14	53	...	...	734.365	Jun. 9, 1908	Jun. 19, 1908	...	...
Highway Railroad	No. 1	...	...	...	...	Referred to a Special Committee by Board of Estimate and Apportionment			
	No. 2	...	...	...	...
NORTHERN Aq. Catskill Aq.	1	50	...	...	156.834	Oct. 9, 1906	Oct. 12, 1906	Jan. 19, 1907	Feb. 18, 1907
	2	43	4.459	...	184.201	Oct. 9, 1906	Oct. 12, 1906	Jan. 19, 1907	Feb. 1, 1907
	3	51	2.366	...	229.685	Sep. 18, 1907	Sep. 27, 1907	Nov. 30, 1907	Dec. 19, 1907
	4	58	5.914	...	306.331	Sep. 18, 1907	Sep. 27, 1907	Nov. 30, 1907	Dec. 19, 1907
	5	65	2.678	...	267.754	Oct. 2, 1907	Oct. 11, 1907	Dec. 21, 1907	Jan. 10, 1908
	6	52	...	1.667	208.942	May 5, 1908	Jun. 5, 1908	...	...
	7	51	14.216	...	48.232	Oct. 15, 1908	Nov. 6, 1908	...	...
	8	40	0.270	...	172.754	Oct. 15, 1908	Nov. 6, 1908	...	...
	...	2	...	...	1.626	...	...	...	...
	...	2	...	...	5.165	...	...	...	...
SOUTHERN Aq. Hillview Res.	1	56	...	...	1.014	Jul. 1, 1907	...	...	*Jul. 25, 1908
	2	63	...	...	88.325	...	...	...	Jul. 22, 1907
	3	66	...	...	74.455	Jan. 25, 1907	Feb. 1, 1907	May 4, 1907	May 21, 1907
	4	76	...	...	45.999	Jan. 25, 1907	Feb. 1, 1907	May 4, 1907	May 21, 1907
	5	91	...	...	186.846	Apr. 3, 1907	Apr. 12, 1907	Jul. 20, 1907	Aug. 22, 1907
	6	79	...	...	24.490	Apr. 3, 1907	Apr. 12, 1907	Jul. 20, 1907	Aug. 22, 1907
	7	86	...	...	34.686	Apr. 17, 1907	Apr. 26, 1907	Jul. 20, 1907	Aug. 22, 1907
	8	53	...	...	495.900	Nov. 8, 1907	Nov. 22, 1907	May 16, 1908	Jul. 28, 1908
	9	89	...	...	76.034	Nov. 8, 1907	Nov. 22, 1907	Jul. 6, 1908	Jul. 21, 1908
	10	100	...	...	73.223	Feb. 19, 1908	Mar. 27, 1908	Jul. 6, 1908	...
Kensico Res.	1	101	...	...	31.810	Feb. 19, 1908	Mar. 27, 1908	Jul. 6, 1908	...
	2	60	...	...	1,043.930	Apr. 21, 1908	Jun. 5, 1908	Sep. 26, 1908	...
	3	53	...	...	1,167.420	Apr. 21, 1908	Jun. 5, 1908	Sep. 26, 1908	...
	4	1	...	...	3.179	May 19, 1908	Jun. 5, 1908	Sep. 26, 1908	Apr. 4, 1908
	5	52	...	0.920	221.633	Sep. 3, 1908	Sep. 25, 1908	Sep. 26, 1908	...
Catskill Aq.	1	44	...	7.170	91.896	Sep. 3, 1908	...	...	...
	2	3	2.590	...	0.540	...	...	...	...
	3	3	...	...	...	...	...	...	...

* Parcel 58A only

TABLE 14

LEASES ENTERED INTO DURING 1908

No.	LOCATION OF PREMISES	DESCRIPTION OF PREMISES	LESSOR	DATE OF LEASE	EXPIRATION OF LEASE	QUARTERLY RENTAL	FLOOR SPACE SQUARE FEET	OCCUPANT DEPARTMENT DIVISION
68	299 Broadway, New York City.	Rooms 1401-04.....	William C. Walker's Sons Wright Barclay, agent	Mar.	1 May 1, '10	\$425.00	....	Headquarters Department Offices
69	299 Broadway, New York City.	Rooms 1418-22....	William C. Walker's Sons Wright Barclay, agent	Mar.	1 May 1, '10	828.75	....	Headquarters Department Offices
72	Grand Street, Walden, N. Y....	2nd floor of two-story frame building.....	Philip Hasbrouck and William D. Sloane	Mar.	16 30 days' notice	15.00	834	Northern Aqueduct
67	Main Street, Chappaqua, N. Y..	1 room on 1st floor.....	Frank T. Bailey	Apr.	1 Apr. 1, '09	45.00	567	Newburg Southern Aqueduct
70	Yorktown Heights, N. Y.....	Building containing 8 rooms and bath.....	Theodore F. Tompkins.	Apr.	1 Apr. 1, '09	60.00	....	Southern Aqueduct Croton
75	Main Street and Maple Avenue, Walden, N. Y.....	2 rooms, 3rd floor.....	Catherine J. Evans.....	Apr.	15 Oct. 22, '08	24.00	....	Croton Northern Aqueduct
71	"Hasbrouck Building," Main Street, New Paltz, N. Y.....	3rd floor.....	Jacob M. Hasbrouck.....	May	1 May 1, '09	270.00	2425	Newburg Northern Aqueduct
74	68 Main Street, Freeport, Long Island.....	2nd floor.....	Charles D. Smith.....	May	7 May 7, '09	150.00	1665	Walkill Long Island
73	Cleveland Street, Valhalla, N. Y.	2-story and attic building.....	Frank M. Campbell.....	Jun.	1 Jun. 1, '09	90.00	878	Nassau Southern Aqueduct
76	"Halcyon Hall," Babylon, Long Island.....	2 rooms, 1-story building, 35' x 100' and 1 vacant lot 35' x 100' 2-story and attic frame building and barn.....	S. R. Waldron.....	Aug.	1 Aug. 1, '09	90.00	4488	Kensico Long Island
79	Crompond road, Cortlandt, N. Y..	2-story and attic frame building and barn.....	Jules Breuchaud and Ber nard F. Coleman.....	Sep.	1 Sep. 1, '09	25.00	1532	Northern Aqueduct Peekskill
77	Main Street and Maple Avenue, Walden, N. Y.....	2nd floor and 2 rooms on 3rd floor of Edmunds building.....	Catherine J. Evans.....	Oct.	1 Oct. 1, '09	120.00	....	Northern Aqueduct Newburg
80	Cornwall-on-Hudson, N. Y.....	Building, known as "Gwyer House".....	Helene Pagenstecher.....	Oct.	1 Oct. 1, '11	300.00	....	Northern Aqueduct Hudson River
78	Corner Wall and John Streets, Kingston, N. Y.....	2 rooms on 2nd floor.....	National Bank of King ston.....	Nov.	4 Nov. 4, '09	45.00	396	Reservoir Real estate
81	Pleasantville, N. Y.....	2-story building.....	Henry S. Forshay.....	Dec.	1 Dec. 1, '11	225.00	2688	Southern Aqueduct Croton

TABLE 15

SCHEDULE OF EMPLOYEES IN ENGINEERING BUREAU ON DECEMBER 31, 1908

TITLE	Headquarters	Reservoir	Northern Aqueduct	Southern Aqueduct	Long Island	Total
Chief Engineer	1	...	...	...	...	1
Consulting Engineers	4	...	...	...	...	4
Department Engineers	1	1	1	1	...	4
Division Engineers	1§	1	4	4	1	11
Designing Engineers	4	...	...	...	...	4
Engineer Inspector	1	...	...	...	...	1
Mechanical Engineers	2	...	...	...	...	2
Electrical Engineer	1	...	...	...	...	1
Architect	1	...	...	...	...	1
Landscape Engineer	1	...	...	...	...	1
Assistant Engineers in charge of section . . . . .	...	...	2	...	...	2
Assistant Engineers, Designer	21	...	1	2	...	24
Assistant Engineers	37§§	31	46	16	21	151
Topographical Draftsmen	19	5	14	7	4	49
Architectural Draftsmen	2	...	...	...	...	2
Mechanical Draftsmen	2	...	...	...	...	2
Assistant Draftsman	1	...	...	...	...	1
Draftsman's Helper	1	...	...	...	...	1
Transitmen	3	...	3	...	1	7
Levelers	1	3	2	2	2	10
Chemists	2	...	...	...	...	2
Photographer	1	...	...	...	...	1
Superintendent of Dam Construction . . . . .	...	...	...	1	...	1
Inspector of Steel	1	...	...	...	...	1
Inspectors of Masonry	5	3	11	...	...	19
Inspectors, Regulating Grading and Paving . . . . .	...	1	2	1	...	4
Inspector of Sewer Construction	1	...	...	...	...	1
Hydrographic Aid . . . . .	...	1	...	...	...	1
Rodmen	6	7	24	11	9	57
Axemen	3	1	17	4	9	34
Private Secretary	1§	...	...	...	...	1
Statisticians	2	...	...	...	...	2
Clerks	29	8	24	5	4	70
Catalogers	4	...	...	...	...	4
Librarians	3	...	...	...	...	3
Stenographers	17	6	9	4	3	39
Typewriting Copyists	5	...	4	...	...	9
Telephone Operators	2	1	...	...	...	3
Messenger . . . . .	...	...	1	...	...	1
Automobile Enginemmen . . . . .	...	...	3	...	...	3
Chauffeur . . . . .	...	1	...	...	...	1
Carpenter . . . . .	...	...	...	...	1	1
General Mining Foreman . . . . .	...	...	1	...	...	1
Mining Superintendent . . . . .	...	...	1	...	...	1
Master Mining Mechanic . . . . .	...	...	1	...	...	1
Mining Shaft Bosses . . . . .	...	...	2	...	...	2
Stationary Mining Engineers . . . . .	...	...	2	...	...	2
Mining Carpenters . . . . .	...	...	13	...	...	13
Miners . . . . .	...	...	55	...	...	55
Mining Blacksmiths . . . . .	...	...	2	...	...	2
Mining Bricklayers . . . . .	...	...	2	...	...	2
Cement Worker	1	...	...	...	...	1
Janitors . . . . .	...	...	5	...	...	5
General Foreman . . . . .	...	1	...	...	...	1
Foremen of Laborers . . . . .	...	5	1	1	2	9
Assistant Foremen of Laborers	1	3	2	...	...	6
Laborers	3	24	40	10	12	89
Cleaner . . . . .	...	1	...	...	...	1
Gage-keepers . . . . .	...	37	...	...	6	43
Totals	191	141	*295	69	**75	771

* Includes 1 Draftsman transferred to Long Island Department, 1 Inspector of Masonry transferred to Headquarters Department, and 1 Inspector of Masonry and 2 Laborers separated; all on December 31, 1908

** Includes 1 Division Engineer and 1 Axeman separated December 31, 1908

§ On staff of Chief Engineer

§§ 1 on staff of Chief Engineer

TABLE 16

SURVEYS MADE BY BOARD OF WATER SUPPLY TO DECEMBER 31, 1908

165

NATURE OF SURVEY	RESERVOIR DEPARTMENT		NORTHERN DEPARTMENT		SOUTHERN AQUEDUCT DEPARTMENT		LONG ISLAND DEPARTMENT		TOTAL	
	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31
Topography										
Triangulation										
Primary Stations Occupied	254	24	.....	33	9	38	.....	33	9	349
Secondary Stations Occupied	55	33	.....	83	.....	.....	.....	126	4	214
Base Line Taping, Miles	4	83	.....	.....	.....	.....	.....	8	7	95
Bench Leveling										
Precise Levels, Miles	.....	560	.....	104	.....	104	.....	265	.....	929
Secondary Levels, Miles	182	223	.....	82	.....	82	.....	928	171	1,415
Surveys										
Measured Line, Miles	50	58	8	58	42	226	58	354	108	668
Acres Surveyed	28,500	59,782	15,794	59,782	2,338	15,436	5,117	29,203	23,249	132,921
Maps										
Acres Mapped, 400 foot scale	21,600	35,971	311	35,971	1,480	1,480	17,055	.....	1,791	59,051
" " 100 "	13,900	1,500	.....	1,500	2,007	6,755	.....	29,055	17,055	51,210
" " less than 100 foot scale	22,700	20,930	4,406	20,930	336	8,902	.....	148	6,413	52,380
" " " "	.....	2,106	261	2,106	.....	599	.....	.....	597	2,705
Aqueduct Line										
Miles Investigated	0.6	1.5	16	370	63	401	50	50	130	823
Final Location, Miles	.....	.....	4	60	11	18	39	39	54	117
Real Estate										
Deeds Investigated	200	3,000	20	497	222	1,350	537	537	979	5,384
Property Surveys										
Numbers	234	1,012	103	350	148	1,311	144	144	629	2,817
Acres Surveyed	1,130	22,693	6,409	20,380	5,483	10,794	410	410	13,432	54,277
" Mapped	2,129	22,693	8,548	22,439	6,092	10,496	410	410	17,179	56,038
" Traced for Appraisal Maps	2,940	15,254	.....	.....	.....	.....	.....	.....	2,940	15,254
Parcel Taking Surveys										
Numbers	40	954	73	505	133	1,040	.....	.....	246	2,499
Acres Surveyed	440	15,254	142	1,741	332	3,678	.....	.....	914	20,673
Acres Mapped	440	15,254	384	1,666	332	3,678	.....	.....	1,156	20,598
Highway Relocated, Miles	18	38	.....	.....	9	16	.....	.....	27	54
Well Borings										
Number Holes (All by Agreement)	.....	.....	.....	209	.....	.....	.....	40	.....	249
Depth in Water, Feet	.....	.....	.....	3,131	.....	.....	.....	1,652	.....	4,783
Depth in Earth, "	.....	.....	.....	24,042	.....	.....	.....	2,348	.....	26,390
Total Depth	.....	.....	.....	27,173	.....	.....	.....	4,000	.....	31,173
Number Holes by Board of Water Supply	.....	.....	.....	9	.....	.....	.....	.....	9	9
Depth in Water, Feet	.....	.....	.....	534	.....	.....	.....	.....	534	534
Depth in Earth, "	.....	.....	.....	573	.....	.....	.....	.....	573	573
Total Depth	.....	.....	.....	1,107	.....	.....	.....	.....	1,107	1,107

TABLE 16 (Continued)

NATURE OF SURVEY	RESERVOIR DEPARTMENT		NORTHERN AQUEDUCT DEPARTMENT		SOUTHERN AQUEDUCT DEPARTMENT		LONG ISLAND DEPARTMENT		TOTAL	
	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	To Dec. 31
Lake										
Number Holes (All by Agreement).....	...	...	...	...	...	58	...	...	16	58
Depth in Water, Feet.....	...	...	...	...	...	2,135	...	...	702	2,135
Earth.....	...	...	...	...	...	320	...	...	320	1,576
Total Depth.....	...	...	...	...	...	1,022	...	...	1,022	3,711
Land										
Number Holes by Board of Water Supply.....	...	...	...	93	...	...	...	...	...	93
Depth, Feet.....	...	...	...	6,974	...	...	...	...	...	6,974
Number Holes, by Agreement.....	...	...	...	521	...	1,324	...	504	236	2,349
Depth, Feet.....	...	...	...	20,742	...	23,968	...	21,627	3,084	66,337
Total Depth.....	...	...	1,107	27,716	...	23,968	...	21,627	3,084	73,311
Grand Total.....	...	...	...	55,996	...	27,679	...	25,627	4,106	109,302
Core Borings										
River and Lake										
Number Holes, by Contract.....	...	...	1	23	...	...	...	...	1	23
Depth in Water.....	...	...	69	1,169	...	...	...	...	69	1,169
Earth.....	...	...	554	4,862	...	...	...	...	554	4,862
Diamond Drill in Rock.....	...	...	80	612	...	...	...	...	80	612
Total Depth.....	...	...	704	6,644	...	...	...	...	704	6,644
Number Holes, by Agreement.....	...	...	**45	**257	...	19	...	...	60	306
Depth in Water.....	...	...	...	...	...	886	...	...	...	...
Diamond Drill in Rock.....	...	...	**7,060	**50,946	...	894	...	...	8,997	54,303
Shot Drill.....	...	...	...	...	...	1,234	...	...	...	...
Total Depth.....	...	...	7,060	50,946	...	1,237	...	...	8,997	54,303
Land										
Number Holes, by Contract.....	...	...	...	4	...	...	...	...	...	4
Depth in Earth.....	...	...	...	1,172	...	...	...	...	...	1,172
Rock.....	...	...	...	1,172	...	...	...	...	...	1,172
Total Depth.....	...	...	...	**257	...	171	...	...	132	532
Number Holes, by Agreement.....	1,133	5,746	...	...	...	6,868	...	...	...	...
Depth in Earth.....	206	2,380	...	...	...	2,336	...	...	...	...
Rock.....	1,339	8,126	...	**50,946	...	13,413	...	...	13,672	72,485
Total Depth.....	...	...	7,060	50,946	...	...	...	...	13,672	72,485
Number Holes by Board of Water Supply.....	...	...	17	31	...	...	...	...	62	201
Depth in Earth.....	694	18,463	642	2,132	...	...	...	...	1,336	20,506
Rock.....	1,043	11,406	353	2,312	...	...	...	...	1,606	13,718
Total Depth.....	1,742	29,869	1,000	4,444	...	...	...	...	2,742	34,313
Grand Total.....	3,081	37,995	8,768	63,204	...	16,770	...	...	19,059	117,969

TABLE 16 (Concluded)

NATURE OF SURVEY	RESERVOIR DEPARTMENT		NORTHERN AQUEDUCT DEPARTMENT		SOUTHERN AQUEDUCT DEPARTMENT		LONG ISLAND DEPARTMENT		TOTAL	
	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	TOTAL To Dec. 31	DURING 1908	To Dec. 31
Test Shafts not less than 30 feet in depth										
Number Shafts.....	...	5	...	2	...	1	...	...	...	8
Depth in Earth.....	...	438	...	15	...	32	...	...	...	485
Depth in Rock.....	...	438	...	529	...	32	...	...	...	529
Total Depth.....	...	876	...	545	...	64	...	...	...	1,016
Test Trenches										
Number Trenches by Board of Water Supply	2	8							2	8
Average Depth.....	3	8							3	8
Total Length.....	67	1,017							67	1,017
Number Trenches, by Agreement.	...	5		9		40			7	54
Average Depth.....	...	8		6		7			3	7
Total Length.....	...	1,010		262		1,273			643	2,545
Total Number Trenches.	2	13		9		7			2	22
Total Average Depth.	67	2,027		262		7			3	7
Test-Pits										
Number Pits.....	35	408		918		445			470	1,771
Total Depth.....	219	3,024		253		1,527			1,746	5,047
Soundings										
Number Soundings.....	6	2,989		2,882		442			3,330	13,523
Experimental Tunnels	26	9,936		52,858		3,355			56,239	145,251
Number Tunnels.....	...	...		...		...			...	...
Linear Feet in Shale.....	...	...		...		...			...	...
Linear Feet in Grit.....	...	...		...		...			...	...
Total Linear Feet.....	...	...		...		...			...	...
Cubic Yards in Shale.....	...	...		...		...			...	...
" " Grit.....	...	...		...		...			...	...
Total Cubic Yards.....	...	...		...		...			...	...
California Store Pipe Wells										
Number Wells.....	...	...		...		...			...	...
Linear Feet of 12-inch Well	...	...		...		...			...	...
" " 14-inch Well.....	...	...		...		...			...	...
" " 16-inch Well.....	...	...		...		...			...	...
Total Linear Feet.....	...	...		...		...			...	...

* Includes Property Surveys

** Including Land and River Holes

TABLE 17

RAINFALL IN INCHES

1908

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	1907	1906	TOTAL
------	------	------	------	-----	------	------	------	------	------	------	------	-------	------	------	-------

CATSKILL MOUNTAIN WATERSHEDS

Esopus

Phoenicia.....	3.25	6.01	2.60	3.04	9.37	2.31	6.09	1.64	3.43	4.35	0.33	2.71	45.13	46.78	44.32
Slide Mountain.....	5.22	6.83	3.83	8.83	8.83	3.18	5.90	1.44	3.37	4.85	0.66	2.97	80.57	53.45	58.72
Edgemount.....	2.80	3.82	2.90	2.62	6.30	2.09	3.85	1.93	2.19	3.51	0.50	2.22	34.72	41.56	42.82
Hunter Mountain.....	3.21	6.69	3.07	3.64	9.24	2.22	6.20	2.57	2.97	3.44	0.59	1.34	46.98	52.90	47.85
Lake Hill.....	3.46	6.73	3.05	3.94	9.19	2.69	6.08	3.20	3.63	6.29	0.74	1.60	51.70	51.70	46.30
Overlook Mountain.....	3.76	7.16	2.67	2.31	10.75	2.10	5.16	2.83	3.41	4.04	0.43	2.51	46.32	49.25	46.30
Zena.....	3.42	7.38	3.19	2.83	8.64	2.05	5.50	2.85	3.02	3.46	0.72	2.71	46.37	41.06	41.55
Kingston.....	3.63	5.83	2.15	2.08	8.77	2.37	6.71	1.63	1.27	3.00	0.43	2.23	41.06	51.55	42.85
West Hurley.....	3.03	5.12	2.35	2.98	8.89	2.44	7.43	1.61	1.96	2.92	0.38	3.18	37.18	47.40	42.01
Brown's Station.....	3.30	6.03	2.12	2.54	8.97	1.92	6.39	1.58	1.43	3.50	0.61	3.01	42.05	47.01	47.91
West Shokan.....	3.34	6.78	3.02	2.89	9.69	1.81	6.71	1.54	1.83	3.57	0.66	3.92	44.13	50.59	47.91
Moonhaw Lodge.....	4.60	8.02	3.54	4.44	11.42	2.19	7.15	1.60	1.32	3.10	0.72	2.71	54.80	50.59	47.91

RONDOUT

Grahamsville.....	2.28	5.36	3.58	4.10	6.36	1.80	6.20	2.26	2.25	3.44	0.96	3.14	41.73	43.24	44.66
Sundown.....	2.04	3.37	3.32	5.69	6.33	2.93	6.32	2.42	2.44	3.04	0.54	3.95	59.52	47.07	46.96
Peekamoose.....	3.02	7.06	3.23	2.84	10.39	2.08	6.32	3.10	3.60	3.26	0.93	3.34	39.11	44.45	42.55
Napanoch.....	3.07	6.83	3.84	2.10	7.83	1.22	3.06	3.51	3.22	3.54	0.84	2.38	44.27	50.23	44.45
Claryville.....	2.93	6.72	3.93	3.11	6.80	1.51	3.96	3.16	1.71	3.90	0.85	3.78	49.42	45.35	45.35
Tabasco.....	2.98	6.07	3.23	3.00	7.90	1.51	4.75	2.48	1.71	2.25	0.71	3.08	49.42	45.35	45.35
High Falls.....	2.72	4.94	2.91	1.80	9.11	2.01	4.70	2.09	1.27	4.12	0.57	2.69	38.93	45.35	45.35

SCHOGHRIE

Windham.....	2.76	6.10	2.06	1.78	6.60	2.84	4.05	2.45	1.82	3.34	0.41	2.05	36.26	27.98	27.98
Raines Falls.....	2.18	8.95	2.68	3.25	9.60	2.51	3.31	2.54	3.12	5.09	0.43	2.75	48.51	32.64	32.64
Lexington.....	1.87	3.35	2.39	2.06	7.40	1.94	3.90	1.24	3.12	3.70	0.34	2.08	37.17	36.84	36.84
Grand Gorge.....	2.07	2.77	2.31	2.06	5.40	1.08	2.87	1.69	2.19	3.17	0.44	1.68	27.17	36.84	36.84
Frattville.....	2.34	2.84	1.40	2.16	5.25	1.78	2.87	2.13	2.08	3.49	0.26	1.63	26.26	36.84	36.84

CATSKILL CREEK

Preston Hollow.....	2.65	3.83	1.89	2.25	5.17	1.30	4.00	2.78	1.37	3.64	0.48	1.45	30.81	34.41	34.41
East Durham.....	2.70	3.52	1.73	2.22	6.63	1.81	5.31	2.56	1.59	2.51	0.37	1.49	30.81	30.88	30.88
Frankton.....	2.14	3.42	1.59	2.06	4.84	1.07	2.33	3.94	2.14	3.04	0.16	1.34	28.27	37.08	37.08
Westie.....	1.90	3.19	1.86	2.44	5.90	1.16	4.23	4.22	1.08	3.32	0.61	1.54	31.53	35.23	35.23

WATERSHEDS WEST OF HUDSON RIVER (OTHER THAN CATSKILL MOUNTAIN)

New Paltz.....	3.16	4.64	3.09	2.34	7.80	3.19	6.36	3.28	1.44	2.02	0.54	2.88	40.74	46.50	46.50
Walden.....	2.26	3.61	2.20	1.57	6.73	2.10	2.37	2.12	1.24	2.06	0.36	2.32	29.14	46.50	46.50

WALKILL

TABLE 17 (Concluded)

MOODNA															
Cornwall.....xx	2.76	4.64	2.74	1.67	9.87	3.00	2.78	3.53	1.25	2.42	0.53	2.41	37.60	51.92	.....
NEVERSINK															
Monticello.....xx	3.01	4.99	3.52	3.13	5.75	1.00	1.35	2.68	2.61	4.29	0.81	2.72	35.86	.....	.....
DELAWARE															
Union Grove.....xx	2.31	3.89	2.50	1.99	5.34	2.41	5.26	2.28	3.20	3.39	0.68	2.10	35.35	.....	.....
WATERSHEDS EAST OF HUDSON RIVER (OTHER THAN CROTON AND BRONX)															
ROELIFF JANSEN															
Bingham's Mills.....xx	2.39	3.55	2.16	1.43	5.40	2.96	5.44	1.75	0.88	2.73	0.30	2.34	31.33	.....	.....
Silvernails.....xx	2.28	2.78	2.41	1.62	4.88	3.94	2.98	3.50	1.05	2.41	0.53	2.26	30.64	.....	.....
WAPPINGER															
Clinton Hollow.....xx	2.52	3.20	3.23	2.33	5.34	2.72	2.68	3.49	1.34	1.55	0.75	2.38	31.53	.....	.....
Pleasant Valley.....xx	3.12	3.24	2.86	2.54	5.93	2.66	4.55	2.76	1.26	1.37	0.74	2.62	33.55	.....	.....
FISHKILL															
Moore's Mill.....xx	3.30	2.93	2.90	2.30	5.17	2.39	6.95	2.74	1.07	1.75	0.58	1.90	33.98	.....	.....
Hopewell Junction.....xx	2.65	4.18	2.79	2.44	5.63	2.81	3.39	3.88	1.14	1.23	0.58	2.47	32.19	.....	.....
PEEKSKILL															
Cold Spring.....xx	3.02	6.36	3.19	1.96	9.28	2.30	4.01	3.66	1.11	2.07	0.25	2.68	39.89	49.45	.....
Pekskill.....xx	3.33	5.15	3.49	1.66	8.78	2.53	5.05	7.07	1.34	1.53	0.76	2.97	43.66	.....	.....
CROTON WATERSHED															
Boyd's Corners.....†	3.97	6.27	3.53	3.23	6.20	2.22	2.50	4.59	1.04	2.09	0.90	3.57	40.11	56.19	48.67
Old Croton Dam.....†	4.95	6.45	4.23	3.45	7.50	2.74	2.92	8.68	1.15	2.16	0.75	2.68	48.66	61.17	48.06
Middle Branch.....†	4.21	5.63	4.08	3.30	6.13	2.26	3.03	6.12	0.83	1.92	1.09	3.32	41.92	59.86	46.54
Carmel Reservoir.....†	3.50	5.16	3.24	2.91	5.73	2.25	2.56	6.32	0.84	1.76	1.08	3.72	39.07	57.94	50.62
East Branch.....†	3.82	5.42	3.52	3.12	6.25	1.85	2.19	5.18	1.46	1.83	1.04	3.12	38.80	56.41	44.00
Amawalk.....†	4.18	6.39	3.90	3.26	7.26	2.46	2.23	7.80	1.04	2.00	1.12	3.42	45.06	57.59	47.00
Titicus.....†	4.93	7.01	4.37	4.11	7.58	1.98	2.25	7.25	1.23	1.90	1.17	3.63	47.41	65.07	52.81
Katonah.....†	4.19	6.54	3.69	3.24	6.17	1.34	2.54	7.97	1.22	2.00	0.99	3.94	43.23	54.14	47.70
New Croton Dam.....††	4.73	6.18	3.84	3.14	6.80	2.70	2.72	6.21	0.99	1.45	0.75	2.87	42.38	51.74	42.57
Croton Falls.....††	3.56	4.62	3.40	2.66	5.56	1.87	6.10	6.10	0.81	1.45	0.94	2.64	36.01	.....	.....
BRONX WATERSHED															
Kensico.....†	4.36	7.43	3.89	2.34	9.12	1.48	6.95	8.78	1.48	2.53	0.95	3.97	53.28	58.30	50.35

† New England Water Works Association (Badger make) weighing gage
 †† Fries standard 8-inch gage
 ††† Fries automatic gage and Fries standard 8-inch gage
 o Fries 12-inch automatic tipping bucket gage and Fries standard 8-inch gage
 † Records of Department of Water Supply, Gas and Electricity
 †† Records of the Aqueduct Commissioners

TABLE 18
STREAM FLOW—CATSKILL WATERSHEDS

MONTH	MEAN MONTHLY DISCHARGE IN CUBIC FEET PER SECOND											
	ESOPUS CREEK						RONDOUT CREEK			SCHOMARS CREEK		
	At Esopus Weir Drainage Area 239 Square Miles		At Kingston Drainage Area 324 Square Miles		At Mt. Marion Drainage Area 378 Square Miles		At Honk Falls Drainage Area 105 Square Miles			At Prattsville Drainage Area 240 Square Miles		
	1906	1907	1908	1907	1908	1907	1906	1907	1908	1907	1908	1908
January.....	....	743	642	1119	874	....	....	251	260	+485	429	
February.....	....	202	803	274	1086	....	1240	252	322	+160	763	
March.....	....	633	1140	890	1452	....	1323	310	516	+648	992	
April.....	....	543	961	772	1106	x836	2157	359	468	+805	720	
May.....	....	594	1567	808	1860	953	1406	202	459	510	957	
June.....	....	416	242	552	336	652	2392	198	84	352	145	
July.....	....	90	136	134	192	162	401	128	39	114	75	
August.....	....	30	56	46	66	50	242	73	39	22	33	
September.....	....	423	36	654	36	859	99	37	149	255	17	
October.....	*363	847	176	1220	196	1352	223	85	279	778	129	
November.....	426	1439	191	2049	190	2177	93	479	38	1333	100	
December.....	359	1116	203	1590	190	1681	239	102	72	1238	194	
The Year.....	....	590	528	842	631	xx 969	834	oo183	194	542	380	

* 13 days' record

x 27 days' record
xx 9 monthso 16 days' record
oo 10 months, 16 days+ From United
States Geological
Survey Record

TABLE 19
YIELD OF CATSKILL WATERSHEDS
GALLONS PER DAY PER SQUARE MILE

MONTH	ESOPUS WATERSHED										RONDOUT WATERSHED			SCHOHARIE WATERSHED	
	ABOVE ESOPUS WEIR			ABOVE KINGSTON			ABOVE MT. MARION		ABOVE HONK FALLS			ABOVE PRATTSVILLE			
	1906	1907	1908	1907	1908	1907	1908	1906	1907	1908	1907	1908			
January.....	2,010,000	1,738,000	2,232,000	1,744,000	2,115,000			1,542,000	1,599,000	1,307,000	1,155,000				
February.....	547,000	2,172,000	546,000	2,166,000	2,257,000			1,548,000	1,983,000	431,000	2,054,000				
March.....	1,711,000	3,085,000	1,775,000	2,897,000	3,678,000			2,206,000	3,178,000	1,745,000	2,672,000				
April.....	1,469,000	2,598,000	1,541,000	2,205,000	2,398,000			1,912,000	2,881,000	1,630,000	1,938,000				
May.....	1,605,000	4,241,000	1,612,000	3,691,000	4,080,000	x1	425,000	3,700,000	1,059,000	1,059,000	1,373,000				
June.....	1,123,000	655,000	1,101,000	670,000	684,000			1,243,000	1,056,000	2,826,000	2,578,000				
July.....	244,000	368,000	1,101,000	670,000	1,112,000			1,218,000	733,000	514,000	391,000				
August.....	82,000	152,000	266,000	383,000	413,000			791,000	143,000	241,000	204,000				
September.....	1,142,000	98,000	91,000	133,000	169,000			449,000	114,000	183,000	61,000				
October.....	*981,000	2,288,000	1,304,000	71,000	74,000			225,000	919,000	87,000	47,000				
November.....	1,151,000	3,889,000	2,434,000	391,000	380,000			520,000	1,724,000	188,000	2,094,000				
December.....	970,000	548,000	4,087,000	379,000	414,000			574,000	2,948,000	234,000	3,580,000				
Average for Year.....	1,599,000	1,388,000	1,686,000	1,259,000	1,424,000	xx1	651,000	1,123,000	1,359,000	1,195,000	1,464,000				
											1,021,000				

* 13 days' record

x 27 days' record
xx 9 months† 16 days' record
‡ 10 months, 16 days

APPENDIX I

OPINIONS RENDERED BY THE CORPORATION COUNSEL DURING 1908

During the year, as necessity arose, the advice of the Corporation Counsel, the legal adviser of the Board, was constantly sought on legal matters involving the powers and duties of the Board.

Herewith is a list of the subjects upon which opinions were received with the date of each:

January 4, 1908. Resolution of the Board of Estimate and Apportionment of December 6, 1907, against incurring new or additional indebtedness payable from proceeds of corporate stock does not apply to obligations previously entered into or to small contracts necessary to maintain The City's plant or position and prevent loss of its property or injury thereto.

January 10, 1908. Fencing aqueduct right-of-way.

January 14, 1908. Resolution of Board of Estimate and Apportionment, December 6, 1907, applies to Board of Water Supply, and amounts to revocation of previous appropriations except to the extent of obligations previously incurred, but does not prohibit payment by Board of Water Supply of its current expenses.

January 20, 1908. Comptroller's consent is not required to the acquisition of land at private sale. Charter, Section 149 does not apply. Section 33 of Chapter 724, Laws 1905, requiring payments to be made in accordance with the laws, regulations and practice "now in force" in regard to payment of money by The City merely gives the Comptroller power to prescribe the clerical details as to vouchers. A written agreement with the owner need not accompany the voucher.

January 30, 1908. Fences and monuments along aqueduct right-of-way.

February 3, 1908. Rent under lease to Board of Water Supply of property acquired by condemnation (lease having been made prior to the commencement of condemnation proceedings) runs until The City acquires the right to take possession upon the payment of the award or an amount equal to one-half the assessed value of the property for 1905.

February 4, 1908. Obtaining legal approval of changes of highways.

February 7, 1908. Maps of additional land adjoining the real estate to which The City has acquired title need not be approved by the Board of Estimate and Apportionment. The Court can in-

corporate the additional land in the proceedings under its power to grant amendments.

February 7, 1908. Apportionment of taxes on land, part of which has been acquired by condemnation.

February 20, 1908. Taking possession of buildings in Kensico Reservoir district.

February 20, 1908. Approving agreement with Wallkill Valley R. R. for acquisition of a perpetual easement through parcel 215, Section 5, Northern Aqueduct.

February 28, 1908. Termination of Agreement 37 with Cranford Co. for construction of shafts at Hudson River crossing.

March 3, 1908. Procedure for obtaining possession of real estate prior to payment of awards.

March 4, 1908. Repeal or modification of the Burr Law (Laws of 1896, Chapter 942) advised.

March 6, 1908. Proposed clauses in contracts as to extra work and furnishing workmen disapproved.

March 13, 1908. Rights-of-way across aqueduct line should be definitely located on maps and not changed except by order of Court.

March 24, 1908. Rights-of-way across aqueduct line should be definitely located on maps and not changed except by order of Court.

March 27, 1908. Obtaining legal approval of highway changes.

April , 1908. Form of proposed agreement with N. Y. Central & Hudson River Railroad Company for use of its land at Hudson River crossing disapproved.

April 30, 1908. Obtaining legal approval of highway changes.

May 7, 1908. Obtaining legal approval of highway changes.

May 7, 1908. Validity of claims for loss of business should be established by claimants by legal proceedings. These claims should not be recognized.

May 8, 1908. Record of ground-water observations on Long Island. Method of preserving same as legal evidence.

May 23, 1908. Possession of real estate should not be taken in advance of payment of awards unless absolutely necessary for construction work.

June 4, 1908. Claims for loss of business should be adjudicated by a separate commission to be appointed for the purpose.

June 18, 1908. Violation of Labor Law by Thomas McNally Co., Contractor under Contract 2, has not been sufficiently proven to justify The City's representatives in declaring it void and refusing payment.

June 22, 1908. City's representative should not take definite position in regard to claims for indirect damage. Meritorious cases which can be settled on a fair and reasonable basis for a small amount should be settled.

June 22, 1908. Payment of one-half assessed value of real estate, possession of which is desired, can be made by the Comptroller on a permissive, as well as a mandatory, order of Court.

June 25, 1908. Board of Estimate and Apportionment can approve map, plan and profile showing method of obtaining water from Suffolk county. Such approval is merely of the project outlined and does not involve any expense to The City or approval of detailed plans or the acquisition of any real estate.

July 15, 1908. Provision suggested for future contracts that contractor may pay amounts necessary to secure possession of land.

July 21, 1908. Board of Water Supply may agree with claimant as to compensation for taking real estate at any time before the Commissioners of Appraisal have adjudicated the claim, and in the event of such agreement the claim must be withdrawn from the consideration of the Commissioners. If a claim is submitted to the Commissioners they are not bound by any agreement reached between the claimant and the Board.

July 23, 1908. Gates and fences at rights-of-way across aqueduct line.

August 27, 1908. Furnishing information in connection with condemnation proceedings.

September 24, 1908. The Supreme Court has power to fix and ascertain one-half the assessed value of real estate, possession of which is desired, where the same forms part of a larger tract assessed as an entirety for 1905 and no apportionment has been made by the tax authorities.

September 29, 1908. Obtaining legal approval of highway changes.

October 3, 1908. Disposition of buildings on land acquired.

October 14, 1908. The expenditures for the ceremonies to commemorate the commencement of construction work were legally incurred by the Board of Water Supply.

December 3, 1908. Fencing aqueduct right-of-way.

December 21, 1908. Duty of Board of Water Supply as to pauper bonds required of contractors.

December 22, 1908. Obtaining possession of real estate prior to payment of awards.

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